BANK OF CANADA

Canada in the Global Economy

Proceedings of a conference held by the Bank of Canada

November 2004

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Introduction

Lawrence Schembri

This conference examined the real and financial linkages between the Canadian economy and those in the rest of the world. It is well known that by most standard measures of openness to trade and financial flows, Canada is among the most open of the industrialized countries.[1] This openness is largely a function of: (i) Canada's relatively small size, compared with other developed countries; (ii) its proximity to the United States; (iii) its strong comparative advantage in natural resources products; and (iv) its economic policy, which, in the postwar period, has been committed to liberalizing trade and financial flows. Canada has profited enormously from its openness to international trade in goods, services, and financial assets through gains from the specialization of production, the expansion of markets, and increased access to new financial instruments to facilitate the diversification of risk. Although the net benefits to the Canadian economy of being so open are clearly positive, the downside is increased exposure to external shocks. Indeed, many of the most significant shocks to the Canadian economy in recent years have come from abroad—and they have become the rule rather than the exception.

Because of Canada's close ties with the rest of the world, comprehending the extent and nature of external linkages, their implications for the

1. In 2003, the sum of Canada's imports and exports exceeded 60 per cent of GDP, which is several times larger than the G-7 average. For more details on Canada's relative openness, see Helliwell and Schembri (2005). It is worth noting that Canada was one of the original signatories to the General Agreement on Tariffs and Trade (GATT) in 1947 and, in 1989, the Canada-US Free Trade Agreement (FTA) came into being, followed by the North American Free Trade Agreement (NAFTA) in 1994. On the financial side, Canada abolished exchange controls in 1951; it was one of the first industrialized countries to do so after World War II.

Canadian economy, and the process by which the Canadian economy adjusts to external shocks is of critical importance in the formulation of monetary policy and in the Bank of Canada's monitoring of the Canadian financial system. The main purpose of this conference, therefore, was to deepen our understanding of these critical issues.

The International Department at the Bank of Canada, host of the conference, is responsible for monitoring and analyzing economic events in the rest of the world. With the other economics departments at the Bank, the International Department analyzes this information to determine the impact of external shocks on the Canadian economy and on the Canadian financial system, and to help develop the appropriate policy response. The goal of the conference was to help improve our own research and the quality of our analysis and advice.

The conference consisted of five sessions, the John Kuszczak Memorial Lecture, and a closing policy panel. Two or three papers were presented in each session, for a total of eleven papers. Six were written by economists from the Bank of Canada and five by economists from universities or other policy institutions. The papers in each session were followed by comments from designated discussants and questions from the floor. Charles Engel of the University of Wisconsin delivered the keynote Kuszczak Lecture, and the members of the policy panel were Mark Carney, Senior Associate Deputy Minister of Finance; John Helliwell,[2] Professor Emeritus in the Department of Economics of the University of British Columbia; and William White, Economic Adviser and Head of the Monetary and Economic Department at the Bank for International Settlements. The panel examined Canada's role in the formulation of international macroeconomic policy. Engel and the panel members also took questions from the floor. This volume includes all of the papers, the discussants' comments, the addresses of Engel and the panel members, and summaries of the question and answer periods. Highlights of the papers are outlined here, together with summaries of the keynote lecture and the policy panel.

Session 1: Financial Market Linkages

Recently, there has been a great deal of interest in financial globalization and the economic implications of increased capital market integration. Although the trend has been towards greater international integration of financial

2. John Helliwell was Special Adviser at the Bank of Canada from August 2003 to July 2004.

markets, the evidence provided in this session's papers indicates that these markets are not as well integrated as some would believe.

Andrew Rose develops a new methodology for testing asset-market integration by examining whether the expected (intertemporal) marginal rate of substitution (EMRS) across different portfolios of equities within and across markets is the same. This test exploits the basic asset-pricing equation, which states that the price of an equity today is the discounted value of the expected future return. In particular, he argues that two portfolios are integrated if they are priced with the same stochastic discount factor given by the inverse of the EMRS. From the asset-pricing equation, Rose derives an estimable empirical model using the percentage return as the dependent variable and the ratio of the equity price to the systemic component of the price as the independent variable (this ratio is a measure of idiosyncratic risk). The coefficient on this variable is the inverse of the EMRS.

Rose obtains estimates of the EMRS by using two data sets: monthly data from 1994 through 2003, and daily data for 2003. These data are from several hundred firms on the Standard & Poor's (S&P) 500, the New York Stock Exchange (NYSE), and the Toronto Stock Exchange (TSX). For the purpose of estimation, he groups the firms into portfolios of 20 stocks. His main finding is that his estimates of the EMRS are the same across portfolios in the same market, as theory would predict, but that they are different across markets, in particular, between the NYSE and the TSX. It is interesting to note that the difference is of similar magnitude between the NYSE and the S&P 500. Hence, these limits to financial integration seem more related to structural differences across financial markets than to national differences.

Jean Imbs examines the impact of financial integration on business cycle correlations, using data for Canadian provinces and US states. This research is motivated, in part, by the well-known "quantity puzzle"—the observation that the correlation of output across countries is positive and larger than the correlation of consumption.[3] One aspect of this puzzle is that financial integration at the international level seems to increase the correlation of output, but standard theory would predict the opposite. Imbs finds that the puzzle disappears when intranational province and state data on output and disposable income (in lieu of consumption data) are used; consumption is more highly correlated across provinces and states than output. He also finds

3. See Backus, Kehoe, and Kydland (1994) for more details. A standard theoretical model with complete financial markets would predict that consumption should be more correlated across countries than output, since consumers use the international financial markets to smooth their consumption profiles.

that these intranational regions are more financially integrated, which permits increased consumption smoothing, and that the increased financial integration reduces output correlations rather than increasing them, as in the case with international data. Hence, it appears that national financial markets are an order of magnitude more integrated than international financial markets, because the empirical results for national markets conform to standard economic theory, whereas those for international markets do not.

Session 2: Exchange Rate Determination in a Global Setting

The primary motivation for these two papers is the unusually large (25 per cent) and rapid appreciation of the Canada-US dollar exchange rate between the first quarter of 2003 and the third quarter of 2004. This appreciation cannot be readily explained by the traditional Bank of Canada exchange rate equation developed by Amano and van Norden (1995). This equation is a regression model of the bilateral real Canadian exchange rate that incorporates a long-run cointegrating relationship between the real exchange rate and the real prices of Canada's energy and non-energy commodity exports. To capture the short-term dynamics, the model includes the short-term Canada-US interest rate differential, as well as the first difference of the Canada-US relative public debt. Both papers in this session begin with the traditional Bank equation and then modify it to improve its explanatory power, in particular, over the recent period of appreciation.

Jeannine Bailliu, **Ali Dib**, and **Lawrence Schembri** focus on the role of multilateral adjustment to US macroeconomic imbalances in determining shifts in the value of the Canadian dollar. They argue that, under normal circumstances, movements in the exchange rate are reasonably well explained by the bilateral Canada-US variables in the traditional exchange rate model. There are, however, situations when US external imbalances are relatively large, such as in the early to mid-1980s and over the most recent period. To redress these imbalances, the Canadian dollar may have to adjust in tandem with the currencies of other countries, because the US economy represents such a large part (about one third) of the world economy. Such exchange rate movements cannot be understood by focusing solely on bilateral Canada-US variables, because the adjustment process is global. The authors consider US fiscal deficits and current account deficits as measures of macroeconomic imbalance and adopt a two-step threshold-regression model that allows the coefficient estimates of the traditional Bank equation to change when these imbalances are large. The first step is to estimate the threshold value of the measured imbalance and then estimate the coefficient with non-linear least squares. The authors find that the US

fiscal deficit, rather than current account deficit, is the appropriate threshold variable. This result is appealing, because current account deficits can occur during investment booms, as in the late 1990s when the US dollar was strong. The result is also consistent with the "twin-deficits" phenomena of the mid-1980s and of the period since 2002. The authors modify the equations to include the two measures of US macroeconomic imbalance and find that the specification of the exchange rate equation changes when the deficit is greater than 2.65 per cent of GDP. Overall, the threshold model represents a significant increase in explanatory power over the traditional model.

John Helliwell, **Ramzi Issa**, **Robert Lafrance**, and **Qiao Zhang** make several modifications to the traditional Bank exchange rate equation. In particular, the traditional equation models the real exchange rate as the dependent variable; Helliwell et al. model the nominal exchange rate. They also replace the real price of energy in the long-run cointegrating relation, which they find is no longer statistically significant, with the ratio of labour productivity in manufacturing to total labour productivity in Canada relative to that in the United States. This latter variable represents the ratio of labour productivity in the traded-goods sector to total labour productivity in the two countries. The estimated coefficient on this variable implies that an increase in Canadian manufacturing productivity, all else unchanged, causes the real and nominal exchange rates to depreciate. The authors argue that this effect is consistent with the impact of a positive supply shock in the traded-goods sector, which necessitates a real depreciation. The empirical model also includes two other short-run explanatory variables in addition to the Canada-US interest rate differential: namely, the emerging-market bond spread to capture shifts in international risk preferences on the Canadian dollar, and the effective US-dollar exchange rate to represent the portion of the movement in the Canadian exchange rate that is driven by the multilateral adjustment of all other currencies relative to the US dollar. The modified model fits the nominal exchange rate well, in and out of sample, and represents a considerable improvement over the traditional equation in terms of explaining movements in the nominal exchange rate.

Session 3: Current Account Dynamics

The Canadian current account measures the net balance on transactions in goods and services between Canadian and foreign residents. For most of its history, Canada has had a current account deficit, largely reflecting the excess of domestic investment over domestic savings. Since 1999, the situation has reversed: the current account has been in surplus and Canadians are, on net, investing abroad. In general, the current account is

determined by a variety of Canadian and foreign variables that reflect current and expected future consumption, production, investment, and savings decisions and the extent to which Canada is linked to the rest of the world by trade in goods and services. The papers in this session extend existing models to better understand the determinants of the Canadian current account.

Hafedh Bouakez and **Takashi Kano** apply the intertemporal model of the current account for Canada to investigate the existence of a Harberger-Laursen-Metzler effect: the proposition that an improvement (deterioration) in the terms of trade causes an increase (decrease) in the current account balance. The rationale for such an occurrence in an intertemporal setting is that a temporary rise in the terms of trade, for example, causes a temporary increase in real income, and consumers will respond by smoothing this income increase over their lifetime consumption. Hence, over the period of the terms-of-trade increase, income goes up by more than consumption, and the current account increases. From their optimizing model of a small open economy, the authors derive a closed-form estimable equation for the current account that is based on current and expected values of the real interest rate, the real exchange rate (defined as the relative price of tradables to non-tradables), real output, and the terms of trade. The empirical model is estimated using quarterly Canadian data from 1962Q2 to 2001Q2. It is reasonably successful: the predicted current account is 60 per cent as volatile as the actual series, which is an improvement over past estimates, and the first three variables are statistically significant and economically meaningful. The terms of trade variable, however, is not found to be significant in explaining Canadian current account fluctuations, given the presence of the other three variables in the equation. This somewhat puzzling result is consistent with similar findings in the literature.[4]

Martin Boileau and **Michel Normandin** examine the joint behaviour of Canadian output, the current account, and the interest rate differential at the business cycle frequency. Their main innovation is to allow for a difference between the domestic and world interest rates, which is determined by the net foreign asset position of the domestic economy. They derive a real business cycle model for a small open economy with three shocks (productivity, government expenditure, and the world interest rate), determine parameter values for the model based on post-1975 Canadian data, and generate dynamic responses of the three variables of interest to the three shocks. The productivity shock is found to have the largest impact, while the impacts of government expenditure and the world interest rate are small to non-existent. The productivity shock raises output and lowers the

4. For example, see Otto (2003).

current account, because investment rises faster than savings, and this reduces the net foreign asset position, which in turn causes the interest rate to rise. The authors then compare the variances and cross-correlations generated by the model to those they compute using the detrended post-1975 quarterly data for Canada. In the data, consumption, the current account, and the interest rate differential are less volatile than output, while investment is more volatile. Only the current account is found to be countercyclical; the other variables are procyclical. The results from the model compare favourably to those from the data; the main discrepancies are that the simulated current account is much less volatile than the actual current account, at around 25 per cent, and the simulated interest rate differential is 2.7 times more volatile than the actual differential.

Session 4: Real Linkages: Canada and the Rest of the World

Although Canada's primary external economic linkages are with the United States, Canada has had very important links with Europe, and in particular, with the United Kingdom. The first paper in this session reviews Canada's trade and investment linkages with Europe and examines how they have changed over the past 40 years, especially in view of the evolution of the European Union from a free trade area with six countries to a virtual economic union with 25 countries.

The second paper in the session shifts geographic perspective 180 degrees to Asia. Although Canada's economic ties with Europe have declined in relative importance, the economic significance of East and South Asia to the global and Canadian economies is growing. The paper focuses on China and India, since they are the largest and among the fastest-growing countries in this region. Since 1990, China and India have grown by 9.3 per cent and 5.6 per cent per year, to become the seventh- and twelfth-largest economies, respectively.[5] Despite this period of rapid growth, the per capita GDP of both countries continues to be well below that of industrialized countries, indicating that there is still considerable potential for growth as their economic resources become more fully and efficiently employed and as capital accumulates as a result of very high savings rates. Although Canada's direct economic ties with these countries, in terms of trade and investment, are relatively small, China and India still have an important effect on Canada through their impact on global markets, especially for commodities and labour-intensive goods. Although careful analysis has not

5. This ranking is based on the use of market exchange rates. If purchasing-power parity rates are used, China and India would be the second- and fourth-largest economies.

yet been conducted, in part because of lack of data, it is widely believed that both countries, especially China, have significantly raised the world prices of commodities through their increased demand, and have lowered the relative prices of many labour-intensive goods, especially consumer items, by increasing supply. Generally speaking, these relative price movements have increased Canada's terms of trade and appreciated the real exchange rate, but at the same time have forced a reallocation of resources within the Canadian economy. The paper examines the reasons underpinning the rapid growth of the Chinese and Indian economies and the effects on Canada.

Brigitte Desroches, **Michael Francis**, and **François Painchaud** examine growth in China and India and the implications for Canada from several different perspectives. They consider the roles of trade liberalization and institutional reform in explaining economic growth in these countries by first documenting the measures that they have already taken. The authors conclude that the two countries have taken significant steps in both areas, but that efforts to promote trade have outpaced institutional reform, especially in China. They perform an econometric analysis with a broad panel data set of over 80 countries to find that these two variables have a synergistic effect on economic growth; in particular, they conclude that trade liberalization in the absence of institutional reform may not have a large impact on growth. Using detailed data on exports, they construct measures of export sophistication that show that both countries have moved up the ladder of comparative advantage in terms of exporting more sophisticated goods. The authors also find that Canada has concentrated its exports farther up the ladder as well, which, the authors argue, could be the result of lower relative prices for less sophisticated goods, driven by China and India's increased contribution to the world supply of these goods. Finally, the authors find that bilateral trade between China and Canada has increased rapidly in recent years (over 157 per cent between 1997 and 2003), which has had a significant impact on economic growth in Canada.

Richard Cameron, **Denise Côté**, and **Christopher Graham** provide a comprehensive and detailed review of Canada's trade and investment links with Europe since 1960. In particular, they examine the evolution of economic integration within the European Union and its ramifications for Canada, and provide a historical overview of Canada-Europe trade relations. They analyze the aggregate bilateral trade and investment data and estimate an export-share model for Canada's trade with European countries. Their main conclusion is that, although Canada's trade with the United Kingdom, especially in non-energy commodities, declined significantly after the United Kingdom joined the European Community in 1973 and Commonwealth preferences were abolished, the rest of Europe has maintained its share of bilateral trade and investment with Canada. The

authors confirm, as well, that Canada's experience was similar to that of New Zealand and Australia. The finding that Canada has been able to maintain its export share with Europe (excluding the United Kingdom) is generally consistent with the facts that trade among industrialized countries has grown faster than GDP over the postwar period, and that Europe has experienced reasonable rates of economic growth over most of this period, owing partly, perhaps, to the formation of the European Union.

Session 5: Real Linkages: Canada and the United States

It goes almost without saying that the United States is Canada's closest economic partner. By almost any measure, whether it is exports (82 per cent), imports (69 per cent), or stocks of inward (64 per cent) or outward (41 per cent) direct investment, the United States is in most cases on the other end of any international transaction Canada undertakes.[6] Although this close economic relationship is driven largely by geographic and cultural proximity and complementary resource endowments, it has been greatly strengthened by the economic policies adopted by the two countries. Capital flows between Canada and the United States have been largely unimpeded. Although the liberalization of trade in goods and services has been more sporadic, the Auto Pact of 1965 was a historic agreement and had a huge impact on the production and trade of automobiles and their parts in North America. The Free Trade Agreement of 1989, followed by NAFTA in 1994, also had a significant impact, as trade of goods and services between the two countries increased dramatically.

The three papers in this session are complementary; they adopt different approaches to analyze the relationship between the Canadian and US business cycles. Generally speaking, they find a close economic relationship between the two economies that has grown closer as bilateral trade has increased.

Marc-André Gosselin, **René Lalonde**, **Jean-François Perrault**, and **Gerald Stuber** examine the determinants of business cycle variations in Canadian output at the industry level. They use output data for Canada and the United States for the years 1963 to 2001; the Canadian and US data are disaggregated by 10 industries and 13 regions (five Canadian and eight US). The authors estimate a state-space model for each industry to decompose business cycle output movements in that industry into a common North

6. The trade data are for 2004, and the stock data for foreign direct investment are for 2003.

American factor, a Canadian factor, and regional and idiosyncratic factors.[7] They find that the Canadian factor is predominant for the Canadian business cycle, but the influence of the common North American factor has increased over the sample, at the expense of regional-specific shocks. On a regional basis, they find, not surprisingly, that the North American factor is most important for Ontario and Quebec. Over the sample, the Canadian factor increases in importance for the manufacturing sector, implying that this sector has become more specialized over time in the products in which Canada has a comparative advantage. The last key result is that industry composition matters, in the sense that the factors that explain output variation across industries are different. Manufacturing and wholesale and retail trade are more related to the North American component, whereas the Canadian factor is relatively more important for most non-traded industries; for the primary sector, idiosyncratic shocks dominate (which may be the result of movements in world commodity prices). Given this variation across sectors, it is critical that monetary policy and other public policy aim at creating a flexible and well-functioning Canadian economy.

Graham Voss examines the synchronization of Canadian and US business cycles at the aggregate and industry levels. He computes partial correlations for Canadian and US output for the period 1963 to 2003 using aggregate data, and at the industry level (nine sectors) for the period 1978 to 2001. At the aggregate level, he tests for a structural break in the output correlations in 1980. Voss finds evidence of an increase in business cycle synchronization at the aggregate level: the Canada-US output correlation is higher after 1980, and the highest correlation takes place in the same quarter, rather than with US output lagged by one quarter, as in the pre-1980 sample. With the industry-level correlations, he finds evidence of a high degree of economic integration between the two economies.

Roberto Cardarelli and **Ayhan Kose** investigate the impact on the Canadian business cycle and labour productivity of the free trade agreements (FTA and NAFTA). They provide a useful review of the literature and evidence of the impact of these agreements on the level and composition of trade flows. They remark that bilateral trade has increased dramatically—exports to the United States have more than doubled as a share of Canada's GDP, from 15 per cent in 1989 to over 30 per cent in 2002—and also note that Canada's exports have become more specialized in manufactured goods and contain more imported intermediate goods. The authors estimate a dynamic-factor model using aggregate output, consumption, and investment

7. In general, state-space models are similar to dynamic-factor models, such as the one presented by Cardarelli and Kose in the final paper of this session; the main difference is the imposition of the restriction to identify the orthogonal dynamic factors.

in Canada and the United States over the period 1960 to 2002 and find that the common North American factor becomes more significant over time, as the bilateral trade flows increased, but the country-specific and idiosyncratic factors remain important. They use a regression model to examine movements in the total factor productivity (TFP) gap between Canadian and US industries and discover that the increased trade has raised Canadian TFP, but that the gap has not been eliminated because of differences in industrial structure between Canada and the United States: the rapidly growing information and communications technology sector represents a smaller share of Canadian industry. Because the TFP gap remains, the authors argue for further efforts to eliminate less obvious barriers to trade, such as regulatory differences, between the two countries.

John Kuszczak Memorial Lecture

In his lecture,[8] **Charles Engel** makes four sequential arguments that lead to his conclusion that co-operative monetary policy aimed at smoothing fluctuations in the Canada-US exchange rate may be welfare-improving. First, using new transactions price data on individual commodities, collected by the Economic Intelligence Unit, he confirms the Engel and Rogers (1996) finding that the law of one price does not hold between Canadian and US cities. He maintains that this evidence is consistent with the hypothesis of local currency pricing. Second, he argues that the Chen and Rogoff (2003) model of the empirically well-established link between commodity prices and the Canadian real exchange rate stems from changes in the relative price of non-traded to traded goods, and he demonstrates that this channel is not consistent with the data. Finally, he develops a simple two-country (Canada-US) model in which commodity price movements imply a real transfer of resources between Canada and the United States. He argues, for example, that a commodity price increase implies that a transfer from the United States to Canada must cause an appreciation in order to restore balance-of-payments equilibrium. Such an appreciation leads to welfare losses, because the resulting relative price movements do not reflect changes in underlying costs, and thus, resources would be misallocated. Hence, there may be scope for co-operative monetary policy to limit exchange rate movements to reduce this welfare loss.

8. This lecture is funded by the Bank of Canada in memory of our esteemed colleague, John Kuszczak, who died in 2002.

Closing Policy Panel: Canada's Role in International Macroeconomic Policy

In past conferences, the closing panel typically provided a critical review of the papers presented. At this conference, however, the panel was asked to reflect on Canada's role in the formulation of macroeconomic policy at the international level, because policy decisions made by bodies such as the G-7, G-20, and the various international forums on financial stability have important implications for Canada as an open economy. Indeed, Canada is unique in the sense that it is "large" enough, in either a political or an economic sense, to be included in such decision making at the highest level, yet sufficiently small that it still resembles the prototypical small open economy with strong economic links to the rest of the world. The three panellists were asked to provide different perspectives on Canada's role.

Mark Carney addressed the G-7 process after spending almost a year as the Canada's G-7 Deputy at the Department of Finance.[9] He made a number of interesting observations about the G-7 process and Canada's role. He began by discussing the G-7 priorities in recent years: he felt that at least half of the G-7's attention was being paid to development and debt issues in the poorest countries, and that oversight of the International Monetary Fund and the World Bank was also an important priority. Other international macroeconomic policy challenges often did not receive the attention one might expect. He felt that there were three international macroeconomic policy issues that are important for Canada, and that Canada has and should continue to push these issues forward by its thoughtful and disinterested analysis and through the Bank of Canada's collaborative efforts with other central banks. In particular, he noted international architecture reform, structural resolution of global imbalances, and current concerns involving oil prices and exchange rates. Canada has an enviable record of recent macroeconomic performance and can draw from that experience to make meaningful interventions on these issues.

John Helliwell provided an insightful overview of a number of the conference papers. He stressed that, despite the rapid growth in international trade and capital flows over the postwar period, many of the papers found that national markets appear distinct. Helliwell noted that these findings of "border effects" have less to do with traditional barriers to trade than with the fact that it may be more efficient to organize economic activity along national lines, given common institutions, similar tastes, and shared values.

9. Mark Carney was on leave from his position as Deputy Governor at the Bank of Canada.

He also noted the importance of institutions, defined broadly to include social capital, for economic growth. He concluded by arguing that middle-level countries like Canada, which the lack the pretense of being military or economic powers, but have made important contributions to the good governance of their own countries as well as to that of the international community, can play an important leadership role. In particular, they can build coalitions for reform within traditional international institutions or lead new policy experiments, such as the G-20, to bridge the policy gap between the G-3 and emerging-market countries.

William White carried on with Helliwell's theme of Canada as an "honest and thoughtful broker" in international macroeconomic policy deliberations. Drawing on his experience as a deputy governor at the Bank of Canada and then economic advisor at the Bank for International Settlements, White provided an insightful and engaging overview of the contribution that Canada (via the Bank of Canada) and individual Canadian economists have made to the intellectual framework for international macroeconomic policy making, to international co-operation, and to the international institutions themselves. He paid particular attention to Canada's involvement in issues pertaining to financial stability.

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Abstracts/Résumés

The Expected Marginal Rate of Substitution in the United States and Canada

Andrew K. Rose

Abstract

The author applies a new methodology to estimate the expected (intertemporal) marginal rate of substitution (EMRS), using only data on asset prices and returns. A novel feature of the technique is that it relies upon exploiting idiosyncratic risk, since theory dictates that idiosyncratic shocks earn the EMRS. The author applies the methodology to two data sets: monthly data from 1994 through 2003, and daily data for 2003. The two data sets include large stocks traded on the New York and Toronto stock exchanges. For both monthly and daily frequencies, the author finds plausible estimates of EMRS with considerable precision and time-series volatility. He then uses these estimates to test for asset integration, within and between stock markets. He finds that both markets seem to be internally integrated in the sense that different assets traded on a given market share the same EMRS. More interestingly, the technique is powerful enough to reject integration between the two stock markets, and between stock and bond markets.

Résumé

L'auteur applique une nouvelle méthode d'estimation de la valeur attendue du taux marginal de substitution intertemporelle en se fondant exclusivement sur des données relatives aux prix et aux taux de rendement sur les marchés d'actifs. Sa méthode a ceci d'original qu'elle met à profit l'information fournie par le risque idiosyncrasique; en effet, selon la théorie, la rémunération des chocs idiosyncrasiques devrait être égale à la valeur attendue du taux marginal de substitution intertemporelle. L'auteur se sert de deux ensembles de données (mensuelles pour la période 1994-2003 et quotidiennes pour l'année 2003) portant sur les actions de grandes sociétés inscrites à la cote des bourses de New York et de Toronto. Pour les deux fréquences, l'auteur obtient des mesures estimatives de la valeur attendue du taux marginal de substitution intertemporelle qui sont à la fois plausibles, fort précises et très volatiles dans le temps. À l'aide de ces mesures, l'auteur évalue ensuite le degré d'intégration interne et croisée des deux marchés boursiers. Les résultats indiquent que les marchés sont intégrés à l'interne, en ce sens que les divers actifs qui y sont négociés présentent la même valeur attendue du taux marginal de substitution

intertemporelle. Constat encore plus intéressant, la méthode élaborée par l'auteur est suffisamment puissante pour permettre de rejeter l'hypothèse d'intégration croisée des deux marchés boursiers ainsi que des marchés boursier et obligataire.

Is There a Quantity Puzzle Within Countries? An Application Using US and Canadian Data

Jean Imbs

Abstract

Fluctuations in disposable income (net of transfers) are more correlated across US states or Canadian provinces than fluctuations in local production. Across countries, consumption plans are less correlated than business cycles, a theoretical anomaly famously labelled a "quantity puzzle" by Backus, Kehoe, and Kydland. In the aggregate, financially integrated regions tend to have highly synchronized GDP fluctuations, as previously documented. In contrast, within countries, financial integration is associated with less correlated business cycles, in a way consistent with the standard international real-business-cycle model. In other words, the quantity puzzle pertains to international data, and it stems from the specific impact of capital flows on international output correlations.

Résumé

Les variations du revenu disponible (net des transferts) présentent une plus forte corrélation entre les États américains ou les provinces canadiennes que celles de la production locale. Les plans de consommation sont moins corrélés d'un pays à l'autre que les cycles économiques, une anomalie théorique que Backus, Kehoe et Kydland ont qualifiée de « quantity puzzle ». Comme l'ont montré des études antérieures, les mouvements du PIB tendent dans l'ensemble à être fortement synchronisés dans les régions financièrement intégrées. À l'échelle nationale, par contre, l'intégration financière est associée à des cycles économiques moins corrélés, conformément à ce que prévoit le modèle international type de cycles réels. Autrement dit, le problème du « quantity puzzle » se manifeste uniquement à l'échelle internationale et découle des répercussions particulières qu'ont les flux de capitaux sur les corrélations de la production entre les pays.

Multilateral Adjustment and the Canadian Dollar

Jeannine Bailliu, Ali Dib, and Lawrence Schembri

Abstract

Rapid and significant appreciations of floating exchange rates, such as that experienced by the Canadian dollar in 2003 and again in 2004, pose a number of challenges for central banks in formulating the optimal monetary policy response, if any. In particular, how the central bank should react depends critically on the underlying forces behind the appreciation. In 2003, the evidence, based on the experience of the exchange rates of other countries, indicated that some of the appreciation of the Canadian dollar reflected a multilateral adjustment to the large US current account and fiscal imbalances.

To capture situations in which the Canadian dollar is being driven largely by the forces of multilateral adjustment to US imbalances, it is necessary to go beyond the standard bilateral empirical exchange rate model. The authors extend the bilateral model used at the Bank of Canada by adopting a threshold methodology that will allow the specification of the empirical model to change when US imbalances are significant. They also add the US fiscal and current account deficits as explanatory variables and find that the augmented threshold model dominates the traditional model in terms of in-sample explanatory power and out-of-sample forecasting ability.

Résumé

En régime de changes flottants, les appréciations rapides et substantielles comme celles qu'a connues le dollar canadien en 2003 et de nouveau en 2004 posent un certain nombre de difficultés aux banques centrales lorsqu'elles doivent définir, le cas échéant, la réaction optimale de la politique monétaire. La réaction de la banque centrale devrait dépendre essentiellement des forces à l'origine de l'appréciation. En 2003, à la lumière de l'évolution des taux de change d'autres pays, il apparaissait que la montée du dollar canadien tenait en partie à un ajustement multilatéral aux importants déséquilibres de la balance courante et des finances publiques aux États-Unis.

Pour rendre compte des situations où le comportement du dollar canadien est surtout dicté par les ajustements multilatéraux liés aux déséquilibres présents aux États-Unis, il convient de ne pas se limiter au modèle empirique habituel du taux de change bilatéral. Les auteurs élargissent le modèle bilatéral utilisé à la Banque du Canada en recourant à une méthodologie à variable de seuil qui permet de faire varier la spécification

du modèle empirique lorsque les déséquilibres observés aux États-Unis sont considérables. Ils incluent également les déficits budgétaire et de la balance courante de ce pays parmi les variables explicatives et constatent que le modèle à seuil surpasse le modèle traditionnel pour ce qui est du pouvoir explicatif à l'intérieur de l'échantillon et de la capacité de prévision à l'extérieur de celui-ci.

NEMO: An Equation for the Canadian Dollar

John F. Helliwell, Ramzi Issa, Robert Lafrance, and Qiao Zhang

Abstract

NEMO is a nominal bilateral exchange rate equation built around a long-run relationship between the real exchange rate, real non-energy commodity prices, and labour productivity differentials with the United States. This relationship is augmented by short-term dynamics that reflect movements in Canada-US interest rate differentials, the evolution of the US dollar relative to other currencies, and a measure of risk perception in international markets.

NEMO's postulated fundamentals are found to be significant and robust. NEMO tracks the data well, both in sample and out of sample, and a dynamic simulation of the equation can account for most of the movements of the exchange rate since 1975.

Résumé

NEMO est une équation de taux de change bilatéral nominal fondée sur un rapport à long terme entre le taux de change effectif, les cours réels des produits de base non énergétiques et les écarts de la productivité du travail observés entre le Canada et les États-Unis. À ce rapport s'ajoute une dynamique de court terme reflétant les variations de l'écart entre les taux d'intérêt canadiens et américains, l'évolution du billet vert face aux autres devises et une mesure de la perception du risque sur les marchés internationaux.

Les valeurs explicatives retenues pour estimer NEMO se sont avérées significatives et robustes. Le modèle s'accorde bien avec les données, tant à l'intérieur qu'à l'extérieur de l'échantillon, et une simulation dynamique de l'équation permet de rendre compte de la plupart des mouvements du taux de change relevés depuis 1975.

Terms of Trade and Current Account Fluctuations: Evidence from Canada

Hafedh Bouakez and Takashi Kano

Abstract

The authors investigate whether extending the intertemporal model of the current account to allow for variations in the terms of trade improves its ability to fit the data. They derive a testable present-value representation of the current account that encompasses the Harberger-Laursen-Metzler effect, according to which a temporary rise in the terms of trade improves the current account. The present-value model is tested using Canadian data. The results show that the cross-equation restrictions implied by the model are rejected by the data, and that terms-of-trade movements have no significant effect on the Canadian current account.

Résumé

Les auteurs tentent de déterminer si le fait d'élargir le modèle intertemporel de la balance courante pour permettre des variations des termes de l'échange produit un meilleur ajustement du modèle aux données. À l'aide d'un modèle d'actualisation vérifiable, ils élaborent une représentation de la balance courante qui englobe l'effet de Harberger-Laursen-Metzler, selon lequel une amélioration temporaire des termes de l'échange fait augmenter le solde courant. Le modèle d'actualisation est testé à partir des données du Canada. Les résultats obtenus indiquent que les contraintes inter-équations découlant du modèle sont rejetées par les données, et que les variations des termes de l'échange n'ont pas d'incidence marquée sur la balance courante du Canada.

The Current Account and the Interest Rate Differential in Canada

Martin Boileau and Michel Normandin

Abstract

For post-1975 Canadian data, the authors document the joint behaviour of output, the current account, and the interest differential at the business cycle frequency. They also interpret this behaviour using a simple model of a small open economy. Their model assumes that agents have access to international financial markets, but face country-specific interest rates on their holdings of world assets. The interest differential depends negatively on the country's net foreign asset position. The authors find that their model matches the Canadian data remarkably well.

Résumé

En s'appuyant sur des données canadiennes recueillies après 1975, les auteurs étudient l'évolution conjointe de la production, de la balance courante et de l'écart entre les taux d'intérêt dans le contexte des cycles économiques. Ils interprètent cette évolution au moyen du modèle simple d'une petite économie ouverte où les agents peuvent accéder aux marchés financiers internationaux, mais reçoivent sur leurs actifs étrangers des intérêts distincts selon le pays créditeur. L'écart de taux d'intérêt est corrélé négativement à la position extérieure nette du pays. Les auteurs constatent l'étroite correspondance entre leur modèle et les données analysées.

Growth and Integration: The Emergence of China and India and the Implications for Canada

Brigitte Desroches, Michael Francis, and François Painchaud

Abstract

The authors examine the growth and integration of the economies of China and India with the world economy and consider the implications for Canada. To do so, they set up a unified framework to address what they refer to as the "growth and integration" puzzle—the lack of empirical evidence to link trade and growth, despite the important role that trade seems to play in many economies. They use their framework to estimate the impact of trade on growth, conditional on the influence of variables that are likely to determine a country's long-run comparative advantage. With this information, they are then able to assess the impact of institutional reform and trade liberalization in countries such as China and India and the impact on countries such as Canada. Their results suggest that while trade liberalization may have had an ambiguous effect on growth in India and China, the positive economic impact of institutional reform was magnified by trade. For Canada, however, the authors find that the integration of China and India into the world economy has contributed positively to GDP.

Résumé

Les auteurs analysent l'expansion économique de la Chine et de l'Inde, l'intégration de ces deux pays à l'économie mondiale ainsi que les conséquences de cette évolution pour le Canada. À cette fin, ils élaborent un cadre unifié qui permet de comprendre l'influence du commerce sur la croissance — lien qui semble important dans de nombreux pays — et ainsi de remédier au manque de données empiriques sur le sujet. Les auteurs se servent du cadre pour estimer cette influence, en tenant compte de variables susceptibles de déterminer l'avantage comparatif à long terme d'un pays.

Grâce à l'information obtenue, ils évaluent ensuite l'incidence des réformes institutionnelles et de la libéralisation des échanges dans des pays tels que la Chine et l'Inde et les retombées pour des pays comme le Canada. Leurs résultats tendent à indiquer que, si la libéralisation des échanges n'a peut-être pas eu un effet évident sur la croissance en Chine et en Inde, elle a par contre amplifié l'incidence favorable des réformes institutionnelles sur le plan économique. Les auteurs constatent, par ailleurs, que l'intégration de la Chine et de l'Inde à l'activité mondiale a été bénéfique pour le PIB du Canada.

Economic Integration in Europe: Its Effects on Canada

Richard Cameron, Denise Côté, and Christopher Graham

Abstract

For the past half century, European countries have undertaken a series of measures that have liberalized trade and factor flows among member states of the European Union (EU). They have also harmonized various government policies, including external commercial policy and monetary policy. This increased integration has greatly expanded economic transactions within Europe, possibly at the expense of trade and factor flows with non-member states, including Canada. In this paper, the authors examine how Europe's increasing economic integration has affected its trade with Canada.

Using a Canadian export share model that controls for relative price competitiveness and relative real income, the authors find evidence that increased European economic integration has reduced Canada's relative exports to the EU. This decline can be attributed almost completely to a dramatic fall in the relative importance of Canadian non-energy commodity exports to the United Kingdom. Moreover, when increased Canada-United States trade is accounted for, Canada's export share to the EU, excluding the United Kingdom, has been stable over the past fifty years, while that of the United Kingdom has trended downwards. This shift in UK imports was likely driven primarily by Britain's co-founding of the European Free Trade Association in 1960, as well as by that country's entry into the European Community in 1973, which left Canada and other Commonwealth countries, such as Australia and New Zealand, without their pre-existing preferential trade treatment.

Résumé

Au cours des cinquante dernières années, les pays européens ont engagé un train de mesures qui a permis de libéraliser les échanges commerciaux et modifié la mobilité des facteurs entre les États membres de l'Union européenne (EU). Ils ont également harmonisé diverses politiques publiques, notamment au chapitre du commerce extérieur et de l'expansion monétaire. Ce mouvement d'intégration a grandement favorisé l'essor des transactions économiques à l'intérieur de l'Europe, peut-être aux dépens des échanges et de la mobilité des facteurs entre le continent et les États non membres comme le Canada. Les auteurs de l'étude dissèquent les répercussions que cette intégration économique a eues sur le commerce canado-européen.

À l'aide d'un modèle d'estimation des parts d'exportation canadiennes qui prend en compte la compétitivité relative et le revenu réel relatif, les auteurs constatent que l'intégration accrue des économies européennes a réduit la part des exportations canadiennes vers l'Europe. Ce recul tient quasi exclusivement à la chute massive de l'importance relative des exportations de produits non énergétiques vers le Royaume-Uni. Qui plus est, si l'on prend en considération la progression des échanges canado-américains, on note que la part des exportations canadiennes vers l'Europe, hors Royaume-Uni, est demeurée stable depuis cinquante ans, alors que les expéditions de produits canadiens à destination du Royaume-Uni se sont inscrites en baisse. Ce courant dans les importations du Royaume-Uni semble induit en grande partie par la création, en 1960, de l'Association européenne de libre-échange, dont le Royaume-Uni est un des membres fondateurs. Il s'explique aussi par l'entrée de ce pays dans la Communauté économique européenne en 1973, adhésion qui priva le Canada et d'autres États du Commonwealth, tels l'Australie et la Nouvelle-Zélande, des liens commerciaux privilégiés avec le Royaume-Uni dont ils avaient bénéficié jusque-là.

Canada's Exchange Rate: New Evidence, a Simple Model, and Policy Implications

Charles Engel

Abstract

The "border effect"—the measure of (lack of) integration of the Canadian and US economies, using deviations from the law of one price—is found to have increased throughout the 1990s before falling sharply from between 2001 and 2004. This finding follows from a new data set of the Economist

Intelligence Unit that uses prices of 97 consumer goods. What lies behind this finding? Apparently, the nominal exchange rate became increasingly misaligned until 2001, but the appreciation of the Canadian dollar since 2001 has reduced the wedge between US and Canadian consumer prices.

The literature reveals that the real value of the Canadian dollar is related to the price of commodities, but posits that the link works through the price of non-traded relative to traded goods. The author presents evidence that tends to refute that link. He offers an alternative explanation in a simple model with local currency pricing for final goods. Optimal co-operative monetary policy in this model indicates that there is a role for stabilizing nominal exchange rate fluctuations.

Résumé

D'après un nouvel ensemble de données recueillies par la société Economist Intelligence Unit sur l'évolution des prix de 97 biens de consommation au Canada et aux États-Unis, l'« effet frontière » — c'est-à-dire le degré d'intégration des deux économies, mesuré selon les écarts par rapport à la loi du prix unique — s'est intensifié tout au long des années 1990, pour ensuite diminuer de façon marquée entre 2001 et 2004. Cette évolution fait écho à celle du dollar canadien, dont le taux de change nominal serait devenu de plus en plus désaligné par rapport à la devise américaine jusqu'en 2001 et dont l'appréciation, depuis, a eu pour effet de rétrécir l'écart des prix à la consommation entre les deux pays.

La littérature révèle l'existence d'un lien entre la valeur réelle du dollar canadien et les prix des produits de base et pose l'hypothèse que les prix relatifs des biens non échangeables et des biens échangeables servent de courroie de transmission. L'auteur présente des données qui tendent à réfuter cette hypothèse. Il propose une autre explication à l'aide d'un modèle simple où les prix des biens finaux sont établis en monnaie locale. Dans un tel modèle, la conduite d'une politique monétaire concertée optimale donne la possibilité d'atténuer les variations du taux de change nominal.

Regional and Industrial Business Cycle Fluctuations in Canada: A North American Perspective

Marc-André Gosselin, René Lalonde, Jean-François Perrault, and Gerald Stuber

Abstract

The growing linkages between the Canadian and US economies are often analyzed in the literature in one of two ways: by looking at trends in bilateral trade flows at the regional and sectoral levels, or by analyzing correlations or commonalities in aggregate business cycle fluctuations. In this paper, Gosselin et al. combine the two approaches. By formally examining Canadian and US business cycles at the industry and region levels, they provide a rich analysis of the extent to which expansions and recessions in these two economies are linked.

Using a unique data set of sectoral output for US and Canadian subnational regions, the authors investigate the extent to which disaggregate Canadian business cycle fluctuations are influenced by North American, Canadian, and region-specific variations in sectoral output. To do so, they identify factors that are common to each industry from North American, Canadian, and regional perspectives, using a state-space approach.

Over the period 1963–2001, the authors find that the common North American, common Canadian, and region-specific components were all important determinants of business cycle fluctuations in Canada's regions and industries. They also find that the share of the variance in Canadian cycles that is common with the United States increased over the sample. This increase was at the expense of region-specific shocks, indicating that economic integration could have led to a reduction in cyclical asymmetries across Canada's regions.

Résumé

Les liens de plus en plus étroits qui unissent les économies canadienne et américaine sont généralement étudiés dans la littérature soit sous l'angle des tendances relatives aux flux commerciaux bilatéraux aux échelons régional et sectoriel, soit du point de vue des corrélations ou des points communs observés dans les fluctuations du cycle économique. Dans la présente étude, Gosselin et ses collaborateurs combinent les deux approches. En examinant formellement les cycles économiques du Canada et des États-Unis aux niveaux régional et sectoriel, ils font une analyse approfondie de la mesure dans laquelle les phases d'expansion et de récession des deux pays sont liées.

À l'aide d'un ensemble de données sectorielles uniques sur la production dans les régions canadiennes et américaines, les auteurs examinent dans quelle mesure les composantes des fluctuations cycliques sont influencées au Canada par les variations nord-américaines, canadiennes et régionales de la production sectorielle. Pour ce faire, ils cernent les facteurs communs à chaque industrie dans une perspective nord-américaine, canadienne et régionale, en recourant à une approche espace d'états.

Pour la période de 1963 à 2001, les auteurs constatent que la composante commune nord-américaine, la composante commune canadienne et la composante régionale ont toutes trois été d'importants déterminants des fluctuations cycliques dans les régions et les secteurs industriels du Canada. Ils observent également que la part de la variance des cycles commune aux économies canadienne et américaine s'est accrue au cours de la période d'estimation aux dépens de la part attribuable aux chocs régionaux, ce qui donne à penser que l'intégration économique s'est peut-être accompagnée d'une réduction de l'asymétrie des cycles entre les régions du Canada.

Aspects of Canadian and US Business Cycles

Graham Voss

Abstract

The author examines the interaction between the business cycles of the US and Canadian economies in a non-structural fashion. His objective is to characterize various aspects of the relationship between the two economies. He sets out to determine whether there has been an increase in the synchronization of the two economies, as might be expected, given their increased integration in recent decades. He finds only weak evidence of increased synchronization. The author then examines correlations between US and Canadian industry sectors and finds no evidence of a border effect. Viewed from an industry perspective, Canada and the United States appear to operate as a single economic region.

Résumé

Dans le cadre d'une recherche non structurelle, l'auteur étudie l'interaction entre les cycles des économies canadienne et américaine dans le but d'en caractériser divers aspects. Il cherche d'abord à déterminer si, comme on aurait pu s'y attendre, l'intégration accrue qui s'est opérée entre les deux économies ces dernières décennies s'est accompagnée d'un plus grand synchronisme de leurs cycles, mais il n'observe que peu de signes donnant à penser que tel a été le cas. Examinant ensuite les corrélations entre les secteurs industriels des États-Unis et du Canada, l'auteur ne constate la

présence d'aucun effet de frontière. Sous une perspective sectorielle, les deux pays semblent donc constituer une seule et même région économique.

Economic Integration, the Business Cycle, and Productivity in North America

Roberto Cardarelli and M. Ayhan Kose

Abstract

The authors examine the effect of the major Canada-US trade agreements on the dynamics of business cycles and productivity in Canada. The North American Free Trade Agreement (NAFTA) and its predecessor, the Canada-US Free Trade Agreement (CUSFTA) have led to a substantial expansion of trade flows. Although common factors have played a larger role in explaining business cycles in Canada and the United States since the early 1980s, country-specific and idiosyncratic factors remain important for Canada. At the same time, while increased trade integration seems to have positively contributed to total factor productivity of Canadian industries, the persistence of structural differences between the two countries has prevented convergence of aggregate labour productivity. While these findings seem to weigh against moving towards a monetary union, they also suggest that substantial benefits could be reaped from further reducing remaining barriers to trade.

Résumé

Les auteurs analysent l'incidence des principaux accords commerciaux canado-américains sur la dynamique des cycles économiques et la productivité au Canada. L'Accord de libre-échange nord-américain (ALENA) et son prédécesseur, l'Accord de libre-échange entre le Canada et les États-Unis (ALE), ont entraîné une expansion considérable des flux commerciaux. L'on ne peut nier le rôle accru que les facteurs communs ont joué dans l'évolution des cycles économiques au Canada et aux États-Unis depuis le début des années 1980, mais force est de constater cependant que les facteurs idiosyncrasiques et les facteurs proprement nationaux demeurent importants au Canada. Parallèlement, bien que le renforcement de l'intégration des échanges semble avoir contribué à améliorer la productivité totale des facteurs dans les secteurs d'activité canadiens, il reste que les différences structurelles persistantes entre les deux pays ont empêché la convergence des taux de croissance de la productivité globale du travail. Si ces constatations militent apparemment contre l'adoption d'une union monétaire, elles semblent aussi indiquer que des bénéfices substantiels pourraient découler de l'abaissement des dernières barrières commerciales existantes.

Session 1:
Financial Market Linkages

The Expected Marginal Rate of Substitution in the United States and Canada

*Andrew K. Rose**

In this paper, I develop and apply a simple methodology to estimate the expected (intertemporal) marginal rate of substitution (EMRS). The EMRS is an economic variable of considerable interest. More importantly, when different series for the EMRS are estimated for different markets (such as the New York and Toronto stock exchanges), comparing these estimates provides a natural yet powerful test for integration between markets. The method is novel in that it exploits information in asset-idiosyncratic shocks.

My primary objective is expositional, and this paper is intended to present a new methodology. Nevertheless, I illustrate the technique by applying it to monthly and daily data covering firms from the largest American and Canadian stock exchanges. It turns out that the method delivers plausible EMRS estimates with considerable precision. Estimates from the Canadian and American markets can be distinguished from each other and from the treasury bill equivalent.

Section 1 presents the methodology; technical details required to implement the technique are discussed in section 2. The empirical results are presented in section 3, and the paper ends with a brief conclusion.

* I thank conference participants at the Bank of Canada and, in particular, Eric Santor, Lawrence Schembri, and Gregor Smith for comments. This study draws heavily on my paper, "Estimating the Expected Marginal Rate of Substitution," co-written with Robert P. Flood.

1 The Methodology

It is easy to motivate this exercise. Asset-market integration is a topic of continuing interest in international finance; see, for example, Adam et al. (2002). It is of special interest in Europe, where continuing monetary and institutional integration have led to lower barriers to asset trade inside the European Union. But economists from other countries should also be interested; after all, the "open" in "small open economy" refers typically to asset-market integration, and is a critical assumption for macroeconomists modelling countries like Canada. Macroeconomists in developed countries almost always assume that financial markets are integrated both internally and with real markets (e.g., goods and services markets through consumption and investment decisions). Open-economy macroeconomists often assume that financial markets in different countries are integrated; that is, they assume away a financial "border effect." But the EMRS is also of interest in itself. Any forward-looking model that uses intertemporal optimization has agents comparing leisure now vs. leisure later, buying assets now vs. later, and so forth; such comparisons are done through the MRS.

I begin with a conventional intertemporal asset-pricing condition:

$$p_t^j = E_t(m_{t+1}x_{t+1}^j), \tag{1}$$

where p_t^j is the price at time t of asset j, $E_t()$ is the expectations operator conditional on information available at t, m_{t+1} is the time-varying intertemporal MRS used to discount income accruing in period $t+1$ (also known as the stochastic discount factor, marginal utility growth, or pricing kernel), and x_{t+1}^j is income received at $t+1$ by owners of asset j at time t (the future value of the asset plus dividends or other income).

I adopt a standard definition of asset integration—*two portfolios are said to be integrated when they are priced by the same stochastic discount factor.* Here, "priced" means that equation (1) holds for the assets in question. Equation (1) involves the moments of m_{t+1} and x_{t+1}^j, not the realized values of those variables. In particular, for integration, I do not require realized values of m_{t+1} to be equated across assets or agents pricing assets.

Although many moments of m_{t+1} are involved in asset-market integration, the object of interest to me in this study is $E_t m_{t+1}$ the time t EMRS. I concentrate on the first moment for three reasons. First, the expectation of the MRS, $E_t m_{t+1}$, is intrinsically important; it lies at the heart of much intertemporal macroeconomic and financial economics and is virtually the DNA of modern aggregate economics. Second, it turns out to be simple to

measure with high statistical accuracy. Third, cross-market differences in estimated values of $E_t m_{t+1}$ are statistically distinguishable, providing powerful evidence concerning market integration.[1] I am testing only for first-moment equality when many additional moments are used in asset pricing; thus, this is a test of a necessary condition for integration. If I reject equality of the first moment, I can reject integration, but failing to reject first-moment equality is consistent with (but does not imply) complete integration.

Consider a standard decomposition of equation (1):

$$p_t^j = E_t(m_{t+1} x_{t+1}^j) = COV_t(m_{t+1}, x_{t+1}^j)$$

$$+ E_t(m_{t+1}) E_t(x_{t+1}^j), \tag{2}$$

where $COV_t(\,)$ denotes the conditional covariance operator. It is useful to rewrite this as

$$x_{t+1}^j = -[1/E_t(m_{t+1})] COV_t(m_{t+1}, x_{t+1}^j) + [1/E_t(m_{t+1})] p_t^j$$

$$+ \varepsilon_{t+1}^j, \text{ or } x_{t+1}^j = \delta_t(p_t^j - COV_t(m_{t+1}, x_{t+1}^j)) + \varepsilon_{t+1}^j, \tag{3}$$

where $\varepsilon_{t+1}^j \equiv x_{t+1}^j - E_t(x_{t+1}^j)$, a prediction error orthogonal to information at time t, and $\delta_t \equiv 1/E_t(m_{t+1})$. The latter time-series vector is the set of parameters of interest. In an integrated market without trading frictions, it is identical for all assets, since the first moment of the MRS should be equal inside integrated financial markets. My work below is concerned essentially with exploiting and testing this restriction.

1.1 Old stuff

It is typical in domestic finance to make equation (3) stationary by dividing the equation by $p_{j,t}$, resulting in:

$$x_{t+1}^j / p_t^j = \delta_t(1 - COV_t(m_{t+1}, x_{t+1}^j / p_t^j)) + \varepsilon_{t+1}^j, \tag{4}$$

where ε_{t+1}^j is redefined appropriately. This normalization converts equation (3) into a traditional asset-pricing equation. That is, it breaks one-period asset returns, x_{t+1}^j / p_t^j, into the risk-free market return, $\delta_t \equiv 1/E_t(m_{t+1})$,

1. In general, there is no guarantee that m_{t+1} is a unique variable; agents behaving according to equation (1) use the entire perceived distribution of m_{t+1} to price assets at t.

and asset-specific period risk premiums, the covariance term. Equation (4) is given economic content by adding two assumptions:

(i) *rational expectations*: ε^j_{t+1} is assumed to be uncorrelated with information available at time t, and

(ii) *covariance model*: $COV_t(m_{t+1}, x^j_{t+1}/p^j_t) = \beta^j_0 + \sum_i \beta^j_i f_{i,t}$, for the relevant sample,

where β^j_0 is an asset-specific intercept, β^j_i is a set of I asset-specific factor coefficients, and $f_{i,t}$ is a vector of time-varying factors. Both assumptions are common in the literature; Campbell, Lo, and MacKinlay (1997) and Cochrane (2001) provide excellent discussions. With these two assumptions, equation (4) becomes a panel-estimating equation. Time-series variation is used to estimate the asset-specific factor loadings $\{\beta\}$, coefficients that are constant across time. Estimating these factor loadings is a key objective of this research.

In practice, many empirical asset-pricing modellers set $\delta(t) = 1 + i(t)$, where $i(t)$ is an appropriate short-term riskless interest rate. That is, the EMRS is simply equated to, for example, the treasury bill rate; it is not estimated at all. While this simplifies empirical work considerably, it assumes integration between stock and money markets, one of the very assumptions I wish to test rather than make.

The first approach to testing asset-market integration between a pair of markets makes one of the factors, say the first one, equal to a market identifier. This allows cross-sectional estimation of a market-specific effect each period. For a set of risk factors that are held to price assets in both markets, the market-specific effects should all be zero under the null of integration. Rejecting the joint null hypothesis—but maintaining rational expectations—rejects either market integration or the risk-pricing model (or both).

Two points are essential to the first approach. First, it is based on the finance standard, where the risk premium is postulated to be a function (usually linear) of a set of aggregate risks. Second, the market integration test is tested as part of a joint hypothesis that includes the aggregate risks that model risk premiums.

1.2 New stuff

In this paper, I rely on a different normalization. Suppose I observe $\tilde{p}^j_t$, which is defined as the value of p^j_t conditional on idiosyncratic information (available at time t) being set to zero. Consider the regression:

$$\ln(p_t^j/p_{t-1}^j) = \alpha_0^j + \sum_{i=1}^{N} \alpha_i^j f_t^i + v_t^j, \tag{5}$$

where the f_t^i are a set of aggregate factors, e.g., the log of unity plus average price growth, and v_t^j, the residual, is the idiosyncratic part of asset j price return. From the definition of $\tilde{p}_t^j$,

$$\tilde{p}_t^j = p_{t-1}^j \exp\left(\alpha_0^j + \sum_{i=1}^{N} \alpha_i^j f_t^i\right), \tag{6}$$

which is p_t^j with its idiosyncratic part set to zero.

Normalizing by $\tilde{p}_t^j$ delivers:

$$x_{t+1}^j/\tilde{p}_t^j = \delta_t[(p_t^j/\tilde{p}_t^j) - COV_t(m_{t+1}, x_{t+1}^j/\tilde{p}_t^j)] + \varepsilon_{t+1}^j. \tag{7}$$

The first term inside the brackets, $(p_t^j/\tilde{p}_t^j)$, equals $\exp(v_t^j)$, which is a function of only idiosyncratic information. The second term, $COV_t(m_{t+1}, x_{t+1}^j/\tilde{p}_t^j)$, is the covariance of the unknown market discount rate, m_{t+1}, with the synthetic return, $p_{t+1}^j/\tilde{p}_t^j$. Similar to the risk-premium assumption in finance, I assume $COV_t(m_{t+1}, x_{t+1}^j/\tilde{p}_t^j)$ moves only because of aggregate phenomena. Since idiosyncratic risk, $(p_t^j/\tilde{p}_t^j)$, is orthogonal to systematic risk, $COV_t(m_{t+1}, x_{t+1}^j/\tilde{p}_t^j)$, equation (7) can be decomposed as

$$\begin{aligned} x_{t+1}^j/\tilde{p}_t^j &= \delta_t(p_t^j/\tilde{p}_t^j) - \delta_t COV_t(m_{t+1}, x_{t+1}^j/\tilde{p}_t^j) + \varepsilon_{t+1}^j \\ &= \delta_t \exp(v_t^j) + u_{t+1}^j, \end{aligned} \tag{8}$$

where $u_{t+1}^j \equiv \varepsilon_{t+1}^j - \delta_t COV_t(m_{t+1}, x_{t+1}^j/\tilde{p}_t^j)$. By design, both parts of the composite error term are orthogonal to the only regressor, $\exp(v_t^j) = p_t^j/\tilde{p}_t^j$. The first part, ε_{t+1}^j, is a forecasting error that is unrelated to all information at time t by rational expectations. The second part, $COV_t(m_{t+1}, x_{t+1}^j/\tilde{p}_t^j)$, is unaffected by idiosyncratic phenomena. Since both terms are orthogonal to the regressor that represents idiosyncratic risk, $(p_t^j/\tilde{p}_t^j)$, the coefficients of interest, $\{\delta\}$, can be consistently estimated via equation (8). A correct empirical specification of $COV_t(m_{t+1}, x_{t+1}^j/\tilde{p}_t^j)$ would lead to more efficient estimation of $\{\delta\}$. However, an empirical specification of $COV_t(m_{t+1}, x_{t+1}^j/\tilde{p}_t^j)$ is unnecessary for consistent estimation.

The basic idea of this study and the essential way it differs from previous work is that I use asset-idiosyncratic shocks to identify and measure the EMRS, or rather, its inverse, $\{\delta\}$. This stands typical finance methodology—the approach discussed above—on its head. In traditional asset-pricing finance, idiosyncratic risk is irrelevant and orthogonal to the centrepiece measures of aggregate risk. By their nature, idiosyncratic risks are easy to insure against and, hence, carry no risk premium. While idiosyncratic shocks carry no information about individual asset-risk premiums, they are loaded with information relevant to market aggregates. The new test for asset-market integration is simple; I check if the implied prices of carrying idiosyncratic risks—measures of the EMRS—are equal across portfolios. If equality of the estimated EMRS cannot be rejected, then the test cannot reject cross-portfolio integration. If, however, I can reject equality, I also reject integration.

This normalization has the advantage—in common with the strategy of Flood and Rose (2003)—that it allows estimation of $\{\delta\}$. However, it does not rely directly on a correctly specified asset-pricing model. That is, I do not explicitly rely on a model of $COV_t(m_{t+1}, x^j_{t+1}/\tilde{p}^j_t)$, such as, e.g., the capital asset-pricing model used by Bekaert and Harvey (1995).

The essential difference between this method and traditional methods is that I substitute a representation of price movements plus an orthogonality condition for a model of $COV_t(m_{t+1}, x^j_{t+1})$, which incorporates a similar orthogonality condition. The advantage of the method is that it deals only with observable variables. The stochastic discount rate, m_{t+1}, is unobservable, as are its moments. When I project asset-price movements onto a set of aggregate factors, I am taking the same stand on relevant aggregates that others take when they model $COV_t(m_{t+1}, x^j_{t+1})$. The advantage of this method is that it leaves a highly volatile regressor—idiosyncratic shocks—attached to $\delta_t = 1/m_{t+1}$.

The new methodology has a number of other strengths. First, it is based on a general intertemporal theoretical framework, unlike other measures of asset integration, such as stock market correlations (see the discussion in Adam et al. (2002). Second, I do not need to model the EMRS directly; I allow it to vary over time in a completely general fashion. Third, the technique requires only accessible and reliable data on asset prices and returns. Fourth, the methodology can be used at a full range of frequencies. Fifth, the technique can be used to compare estimates of EMRS across many classes of intertemporal decisions, including savings decisions that involve domestic and foreign stocks, bonds, and commodities. Sixth, the technique is easy to implement and can be applied with standard econometric packages; no

specialized software is required. Finally, the technique focuses on estimating an intrinsically interesting object, the (inverse of the) EMRS.

2 Taking It to the Data

In practice, $\tilde{p}_t^j$ is an unobservable variable. Thus, I use an observable statistical counterpart derived from an empirical model, denoted $\hat{p}_t^j$. (Note that this induces measurement error, an issue I handle below.) I do this in a straightforward way, using simple time-series regressions that link individual asset-price returns to the average. In particular, I estimate the following J time-series regressions via ordinary least squares (OLS):

$$\ln(p_t^j / p_{t-1}^j) = a_j + b_j * \ln(\bar{p}_t / \bar{p}_{t-1}) + v_t^j, \tag{9}$$

where a_j and b_j are fixed-regression coefficients, $\bar{p}_t$ is the market-wide average price, and v_t^j is the time-t asset-idiosyncratic shock. This equation has a natural and intuitive interpretation; it models the first difference of the natural logarithm of a particular asset price as a linear function of the price growth of the market. Estimates of equation (9) allow me to produce the fitted value of $\tilde{p}_t^j$, which I define as:

$$\hat{p}_t^j \equiv p_t^j * \exp(\hat{a}_j / \hat{b}_j * \ln(\bar{p}_t / \bar{p}_{t-1})). \tag{10}$$

I am not sentimentally attached to this specific model of $\hat{p}_t^j$. I could instead employ the Kalman filter to avoid using future data and allow for moving coefficient estimates. Alternatively, one could add additional regressors to equation (9) to control for more aggregate factors.[2] I have assumed that the log first difference of prices is linear in the market; one could change the particular functional form assumption. I have used a time-series approach to estimate $\hat{p}_t^j$, but a cross-sectional approach is also possible. None of these assumptions is critical; they simply seem to work in practice.[3] But while this setup has delivered sensible results, I stress that one only needs *some* model for $\hat{p}_t^j$, not this particular one.

2.1 Estimation issues

I am interested in estimating $\{\delta\}$ from the following model:

2. I have experimented with additional regressors suggested by Fama and French (1996), and they seem to make no difference to the results in practice.

3. For instance, the median R^2 from the twenty estimates of equation (9) is a respectable .77, and the lowest of the twenty R^2s is still .59.

$$x^j_{t+1}/\hat{p}^j_t = \delta_t(p^j_t/\hat{p}^j_t) + u^j_{t+1} \tag{11}$$

for assets $j = 1, \ldots, J$, periods $t = 1, \ldots, T$. I allow $\{\delta\}$ to vary arbitrarily period by period.

Using $\hat{p}^j_t$ in place of the unobservable $\tilde{p}^j_t$ might induce important measurement error. Hence, it is natural to consider estimation of equation (11) with instrumental variables (IVs) for consistent estimation of $\{\delta\}$. IV is also known to handle the "generated-regressor" issue, which has long been associated with potentially overstated precision of standard errors; see Shanken (1992) and Cochrane (2001 and website correction[4]). The latter shows that this is typically not important in practice, especially for monthly data. While IV estimation seems natural, estimation via generalized method of moments (GMM) allows me to handle both potential econometric issues, while not requiring independent and identically distributed disturbances. Accordingly, I use and compare two estimation techniques, IV and GMM (I sometimes also use OLS for simplicity). As IVs for $\{p^j_t/\hat{p}^j_t\}$, I use the set of time-varying market-wide average prices, $\{\bar{p}_t\}$.

2.2 The data sets

I employ two data sets. The first is a decade of monthly data, spanning 1994M1 through 2003M12, while the second is a year of daily data for 2003. I use different frequencies for intrinsic interest and to check the sensitivity of my technique. Though these frequencies are standard in finance, there is nothing special about them, and there is no obvious reason why the methodology could not be used at either higher or lower frequencies. I focus on stock markets, but again see no reason why bond and other markets could not be considered.

My American stock data were extracted from the Collaborative Research Support Program (CRSP) database and consist of month-end prices and returns (including dividends, if any) for all firms in the Standard and Poor (S&P) 500 (as of the end of 2003). I have adjusted for stock splits and have checked and corrected the data. I retain only the 435 companies that have data for the full sample span.[5]

4. <http://gsbwww.uchicago.edu/fac/john.cochrane/research/Papers/typos.pdf>.
5. This might lead to selection bias, but of ambiguous sign. Firms that disappear from the sample leave because of either positive idiosyncratic shocks and merger/takeover, or negative ones and bankruptcy/takeover. This issue merits more attention.

Since I am interested in estimating and comparing implied EMRS across markets, I also include data from the Canadian market. In particular, I add comparable data for the firms in the S&P/TSX Composite Index of the Toronto Stock Exchange (TSX). This data set is extracted from Datastream, and I convert Canadian dollars into American using comparably timed exchange rates. Canadian equity may be more concentrated in firms that specialize in commodities, and may also be more likely to be closely held by families. It is thus interesting to compare the Canadian EMRS with its American counterpart.

For the monthly data set, I have 120 observations on 389 firms from the S&P 500 traded on the NYSE and 152 firms from the TSX. For the daily data set, I have data for 247 business days when both the Canadian and American stock exchanges were open, on 440 NYSE firms and 223 TSX firms.

It has been traditional since at least Fama and MacBeth (1973) to use yields on short-horizon Treasury bills to proxy the risk-free rate, and it is natural for me to compare the estimates of the expected risk-free rate with Treasury bill returns. I use data on Treasury bill returns downloaded from the website of the Board of Governors of the Federal Reserve System.

Finally, for purposes of estimation, I place stocks into portfolios, typically in groups of twenty. I do this randomly (alphabetical order of ticker), though I see no reason why one could not group firms on the basis of beta or size, for example. I use portfolios partly to remain within the finance tradition followed since Fama and MacBeth (1973). But using portfolios also makes my task more difficult, since portfolios have lower idiosyncratic risk and reduce cross-sectional dimensionality. It does not hinder my ability to estimate the parameters of interest to us, although there is no obvious reason why individual securities could not be used in place of portfolios.

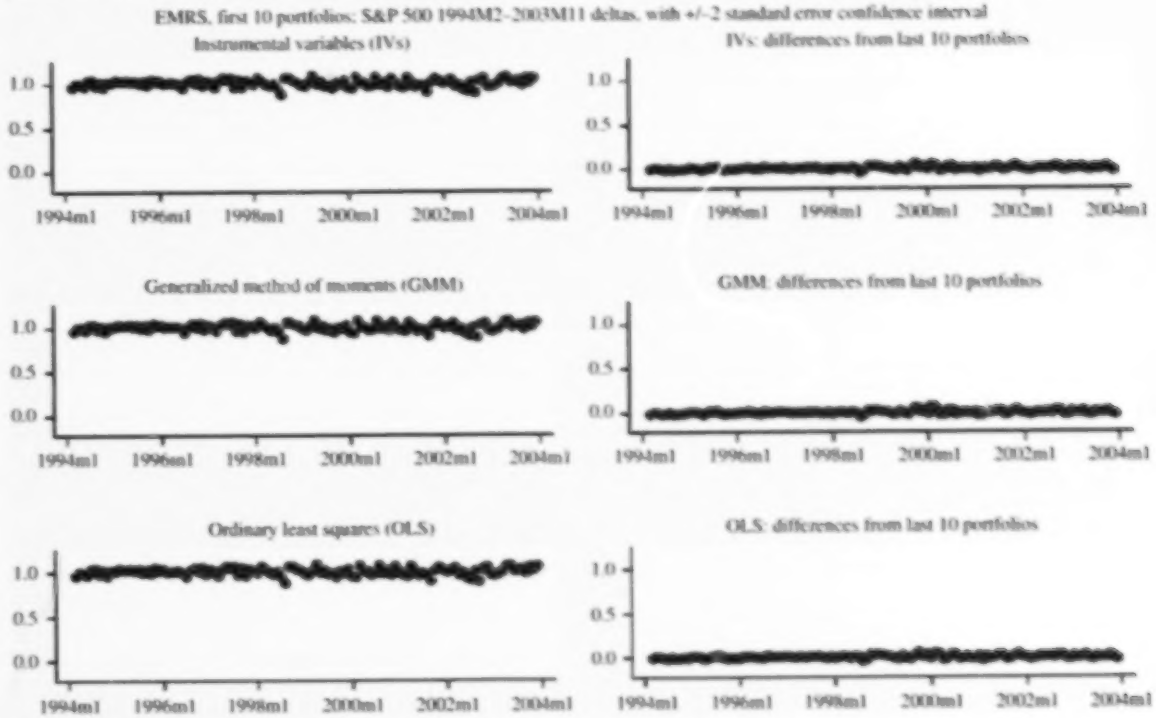
3 Results

The focus of this paper is estimating the EMRS, and I begin with an illustration that relies on monthly data from 400 firms in the S&P 500, grouped into portfolios of twenty firms.[6] I have 118 observations between February 1994 and November 2003, since I lose an observation at either end of the sample, owing to leads/lags.

The three graphs on the left in Figure 1 portray estimates of the EMRS from equation (11), denoted $\{\hat{\delta}_t\}$. These were estimated using three different techniques: IV, GMM, and OLS. In each case, I use data from only the first ten portfolios. The mean of $\{\hat{\delta}_t\}$ is plotted, along with a +/−2 standard error

6. These firms are traded mostly on the NYSE, but a few are on the NASDAQ.

Figure 1
Estimated EMRS, portfolios of 20 S&P 500 firms, 1994M2–2003M11: different estimators



confidence interval band. The OLS and GMM point estimates are identical (by construction) and are highly correlated with the IV estimates. The primary differences between the different estimates lie in the standard errors; all three estimators deliver small standard errors, with the GMM standard errors being slightly smaller than those of either IV or OLS (but with more period-to-period volatility).[7] Indeed, I rarely find significant differences between the three estimators, and thus tend to rely on IV.[8]

Even though I estimate the expected MRS from only ten portfolios, the results appear sensible. Most of the estimates of the (inverse of the) expected monthly MRS are just over unity. The sample average of $\{\hat{\delta}_t\}$ over the 118 periods is around 1.0085, implying an annual MRS of slightly over 1.1 ($= 1.0085^{12}$). While somewhat high compared to, for example, Treasury bill returns, this figure is certainly plausible in magnitude. Furthermore, the measures of EMRS are estimated with precision; the confidence interval is barely distinguishable from the means in the plots. Still, the most striking feature of the EMRS is not its mean, but its volatility over time. The standard deviation of $\{\hat{\delta}_t\}$ is around .04 for all estimators, and the point estimates vary over the decade between .88 and 1.09. This considerable volatility in the EMRS mirrors my (2003) results with Flood as well as the famously high lower bound of Hansen-Jagannathan (1991).[9]

3.1 Integration within the S&P 500

Do the results depend on the choice of portfolios? An easy way to check is to estimate $\{\hat{\delta}_t\}$, using data from all twenty portfolios and to examine the differences from the ten-portfolio estimates. This is done on the right side of Figure 1, which graphs the mean and confidence intervals of the EMRS for the three estimators. In particular, the graphs on the right portray the difference between $\{\hat{\delta}_t\}$ estimated from all twenty portfolios, and $\{\hat{\delta}_t\}$

7. One can compare the differences between the estimators with a Hausman test. In this case, the difference between the OLS and IV estimators turns out to be economically small but marginally statistically significant; the hypothesis of equality is rejected at the .006 confidence interval. Also, robust standard errors (either clustered by portfolio or not) are typically even smaller.

8. The exception is bootstrapped tests for integration, where I tend to use OLS for computational simplicity.

9. The estimates of EMRS have essentially no persistence and are also uncorrelated with traditional finance factors, such as the three used by Fama and French (1996). Adding either an intercept or portfolio-specific intercepts to the estimating equation (11) changes results little, which is not surprising since the former are small and of marginal significance; the same is basically true of time-specific intercepts. Finally, I have added the three time-varying Fama-French factors to the first-stage equation (9); this makes no substantial difference to my results.

estimated from only the last ten portfolios. The differences are economically small; they average around .003 (for all three estimators). They also have large standard errors (of around .011), so that the differences do not appear to be statistically significant. In an integrated market, all securities should deliver the same EMRS. Figure 1 thus delivers little evidence of significant departures from integration inside the S&P 500.

The columns on the right of Figure 1 compare $\{\hat{\delta}_t\}$ on a period-by-period basis for a given estimator. That is, the figures implicitly ask whether the EMRS for, say, February 1994, is the same when estimated from all twenty portfolios and only from the last ten. This is interesting, because equality of $\{\hat{\delta}_t\}$ derived from different assets is a necessary (but not sufficient) condition for market integration. But it is also interesting to compare the entire set of estimated EMRS simultaneously, that is, to test formally for joint equality. If the disturbances—$\{\hat{u}_t^i\}$—were normally distributed, this test would be easy to compute via a standard F-test. However, and unsurprisingly, there is massive evidence of non-normality in the form of fat tails (leptokurtosis). Accordingly, I estimate the distribution for my critical values with a conventional bootstrap. With the bootstrapped results, I find that the hypothesis of joint equality $\{\hat{\delta}_t\}$ for all 118 observations cannot be rejected at any conventional significance level (for any estimator). That is, I cannot reject integration within the S&P 500. While this might only indicate a lack of statistical power in the technique, I will show that it is easy to reject equality of $\{\hat{\delta}_t\}$ across substantively different markets.

3.2 Stock and bond markets

The hypothesis of equality of $\{\hat{\delta}_t\}$ cannot be rejected when the twenty stock portfolios are split up. But are the estimated EMRS similar to Treasury bill returns? No. It is easy to generate the risk-free rate using an actual interest rate; I simply create $\hat{\delta}_t = (1 + i_t)$, where i_t is the monthly return on nominal Treasury bills. The sample average of $\{\hat{\delta}_t\}$ is around 1.003 (around 3.7 per cent annualized), somewhat lower than, but close to, the sample average of $\{\hat{\delta}_t\}$.

But while the first moments of the estimated risk-free rate and the Treasury bill equivalent are similar, the second moments are not. The Treasury bill rate has considerably lower time-series volatility than the estimated EMRS. The standard deviation of $\{\hat{\delta}_t\}$ (across time) is .001, which is smaller than that of $\{\hat{\delta}_t\}$ by a factor of over thirty! Since the estimated risk-free rate is so much more volatile than the Treasury bill equivalent, it is unsurprising that

the hypothesis of equality between the two can formally be rejected at any reasonable level of significance.[10]

To summarize, my estimates of the time-varying expectation of MRS are intuitively plausible in magnitude, and precisely estimated. They also display considerable volatility over time. While this variation is consistent with the literature, it is grossly at odds with the smooth Treasury bill return. Unsurprisingly, I can reject equality between my estimates of EMRS and those of the Treasury bill.

3.3 The TSX

What of different markets? Figure 2 provides estimates of the EMRS (along with a +/–2 standard error confidence interval) derived from the NYSE and the TSX. In both cases, I use twenty portfolios to estimate the expected risk-free rate. The number of available stocks differs by exchange; I use portfolios of nineteen stocks each from the NYSE, but those from the TSX have seven stocks. I estimate $\{\hat{\delta}_t\}$ in the same way as above, using IVs for 118 observations between 1994M2 and 2003M11. To facilitate comparison, I also graph the MRS implicit in the short Treasury bill return.

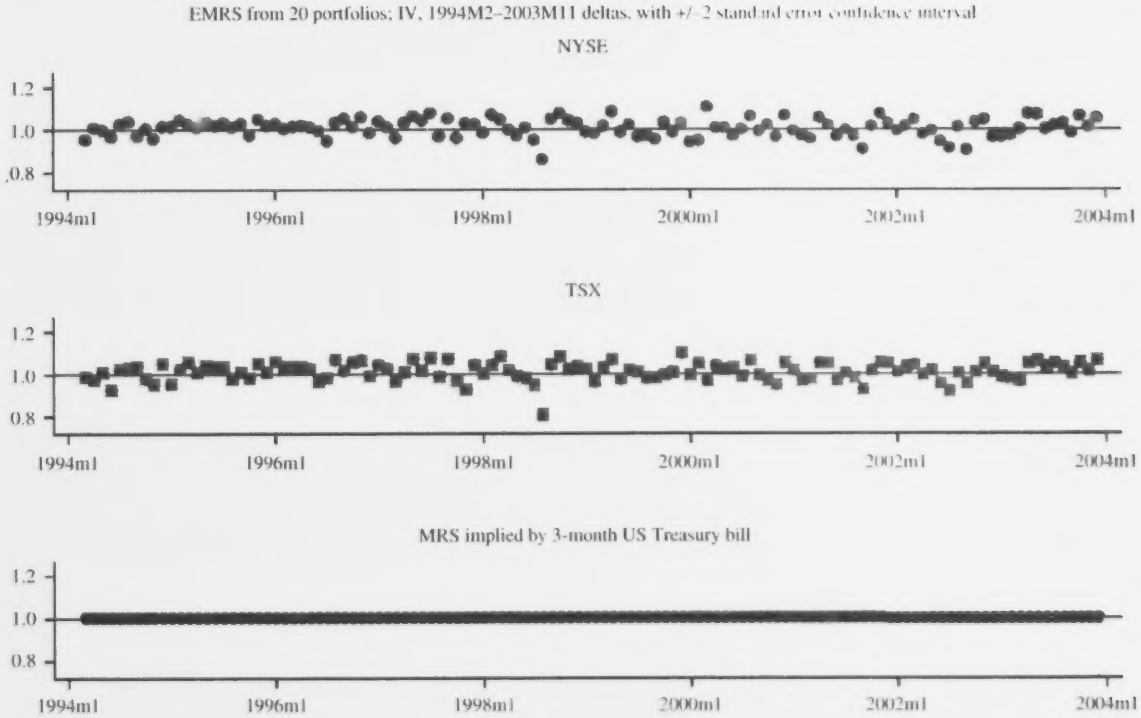
For both markets, the average value of EMRS seems reasonable, being slightly over unity. These are again estimated with considerable precision; the confidence interval can hardly be distinguished from the mean. But again, the single most striking feature of the estimates is their time-series volatility. The standard deviation (over time) of $\{\hat{\delta}_t\}$ is .04 for both the NYSE and the TSX. While this is consistent with received wisdom in finance (e.g., Hansen and Jagannathan 1991), it contrasts starkly with the smooth Treasury bill return portrayed at the bottom of Figure 2.

My results for both markets are tolerable and consistent with my earlier findings. Different estimators (OLS, GMM, and IV) deliver economically similar results that are statistically close (Hausman tests sometimes reject equality and sometimes do not). There is considerable leptokurtosis. And bootstrapped tests for internal integration indicate no evidence that using, e.g., ten TSX portfolios delivers significantly different estimates of the expected MRS from using all twenty TSX portfolios. That is, I find no evidence against internal integration for either market.

I consider these results reassuring, given the depth and liquidity of the two stock markets I consider. But the results might simply indicate a lack of

10. The F-test statistic for equality between the EMRS and the Treasury bill return is over 50; under the null hypothesis of market integration, it has degrees of freedom (118, 2360). Bootstrapping the critical values has no substantive effect on conclusions.

Figure 2
Estimated EMRS, 1994M2–2003M11: different markets



power in my statistical techniques; after all, they are simply not rejecting a necessary (but not sufficient) test for market integration. Accordingly, as a more stringent measure, I also test formally for integration across markets.

I begin comparing the estimated risk-free rate across markets with a series of scatter plots in Figure 4. The top two graphs on the left of the figure compare monthly estimates of $\{\hat{\delta}_t\}$ from the TSX (on the *y*-axis) against those derived from the NYSE (on the *x*-axis). At the bottom left, I also provide a comparable graph using the Treasury bill rate on the ordinate. Clearly, the estimates of the EMRS from the TSX are correlated with that from the NYSE; the correlation coefficient is .73. However, they are not identical; the mean absolute difference between the $\{\hat{\delta}_t\}$ derived from the NYSE and the TSX is .02, and almost 3 per cent are greater than .1.

It is straightforward to formally test the hypothesis that the estimated EMRS are equal across markets. One way to do this is to test for equality between the estimates graphed in Figure 4. While this is perfectly acceptable (and is the method I use for the daily results below), I note that the portfolios used to estimate $\{\hat{\delta}_t\}$ graphed in Figure 4 have different numbers of stocks. Thus, they have different degrees of estimation precision. To "balance the playing field," I construct twenty NYSE portfolios with nineteen stocks each. I can then use simple Chow tests to test for equality between $\{\hat{\delta}_t\}$ derived from the twenty NYSE portfolios with those that also use the eight TSX portfolios (again, of nineteen stocks). When I do so, I find strong evidence against integration. The *F*-test for integration between the NYSE and the TSX is over 8, strongly rejecting the null hypothesis of integration (even allowing for non-normally distributed disturbances that I explore through the bootstrap). Evidently, there is at least one source of divergence between the national stock markets of the United States and Canada.

While my estimates of the EMRS are similar for the two markets, they are significantly different in both the economic and statistical senses. That is, I am able to reject the hypothesis of equal EMRS across markets, and thus market integration. This result is interesting, since there are few obvious reasons for this segmentation. Moreover, the estimates indicate that my methodology is not lacking in statistical power.

3.4 Daily results

Thus far, I have used a decade of monthly data. I now present results derived from the most recent available year of daily data, 2003. I use closing rates for the 245 days when both markets were open, converting Canadian-dollar quotes from the TSX into American dollars, using a comparable exchange

rate. I consider the same two markets, noting that both the American and Canadian markets close at 4:00 p.m. daily in the same time zone.

Figure 3 is the daily analogue to the monthly estimates displayed in Figure 2 (the GMM analogue is in Figure 5). In particular, I plot the mean of the EMRS for both markets, along with a +/–2 standard error confidence interval (the Treasury bill equivalent is also plotted at the bottom of the figure). I use IV as my estimator, although essentially nothing changes if I use OLS or GMM. In each case, I estimate $\{\hat{\delta}_t\}$ using twenty portfolios; each NYSE portfolio has 22 stocks, and each TSX portfolio 11.

As with the monthly data set, the means of the series again seem reasonable; they are 1.001 and 1.001 for the NYSE and TSX, respectively. These magnitudes seem intuitively reasonable, if somewhat high; they are roughly comparable in order of magnitude to the Treasury bill interest rate, which averaged just over 1 per cent in 2003. The series of EMRS are also estimated with considerable precision in tight confidence intervals. There is again evidence of leptokurtosis. Still, the most striking feature of all three series of the estimated MRS is their volatility over time. This is especially true when one compares them with the virtually flat Treasury bill return. It is little surprise, then, that the hypothesis that the daily estimates of $\{\hat{\delta}_t\}$ derived from S&P 500 stock prices are statistically far from the Treasury bill equivalent $\{\hat{\delta}_t\}$.[11]

When I check for internal integration within a market (such as S&P 500 stocks traded on the NYSE) by comparing estimates of $\{\hat{\delta}_t\}$ derived from different sets of portfolios, I am unable to reject the hypothesis of equality at any reasonable confidence interval. That is, I (unsurprisingly) find no evidence against integration within markets.

However, as with the monthly data, integration across markets is another story. The scatter plots of the estimated daily EMRS at the right side of Figure 4 are analogous to those with monthly data, immediately to the left. The TSX delivers $\{\hat{\delta}_t\}$ that are positively correlated with those from the NYSE; the correlation coefficient is .69. The mean absolute difference between the series is approximately .006, and ranges to over .02. While these may seem small, they are economically large, since they are at a daily frequency. In any case, the series are statistically distinguishable. When I test for equality between the estimates of $\{\hat{\delta}_t\}$ portrayed in Figures 3 and 4, I find the hypothesis rejected for the NYSE against the TSX (the F-test statistic is over 17). Bootstrapping the critical values does not reverse these conclusions.

11. The F-test statistic for equality between the EMRS and the Treasury bill return is over 150.

Figure 3
IV daily estimates of EMRS, 2003

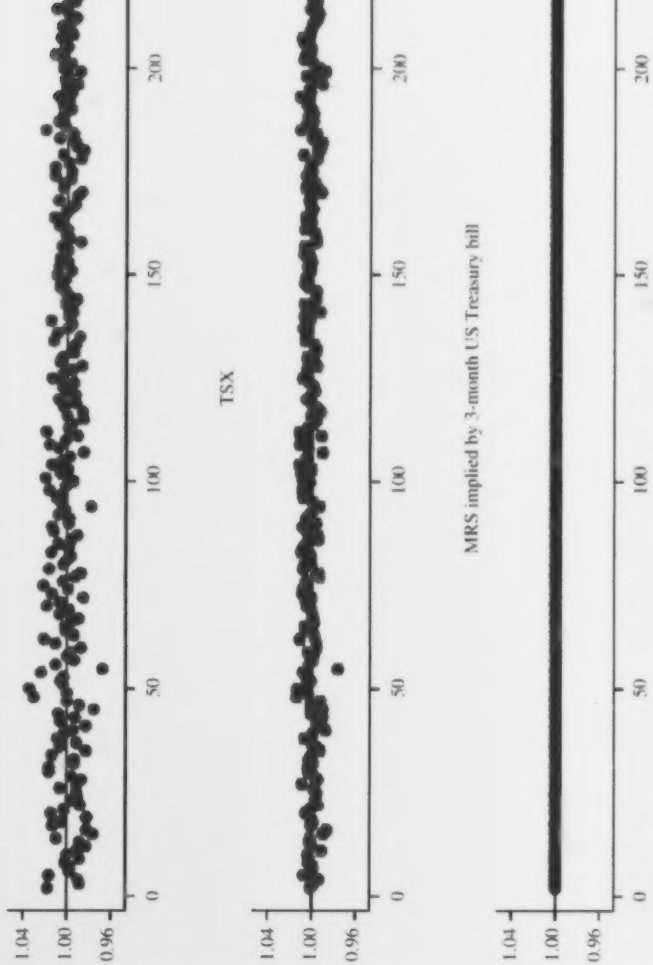


Figure 4
Scatter plots of estimated EMRS across markets

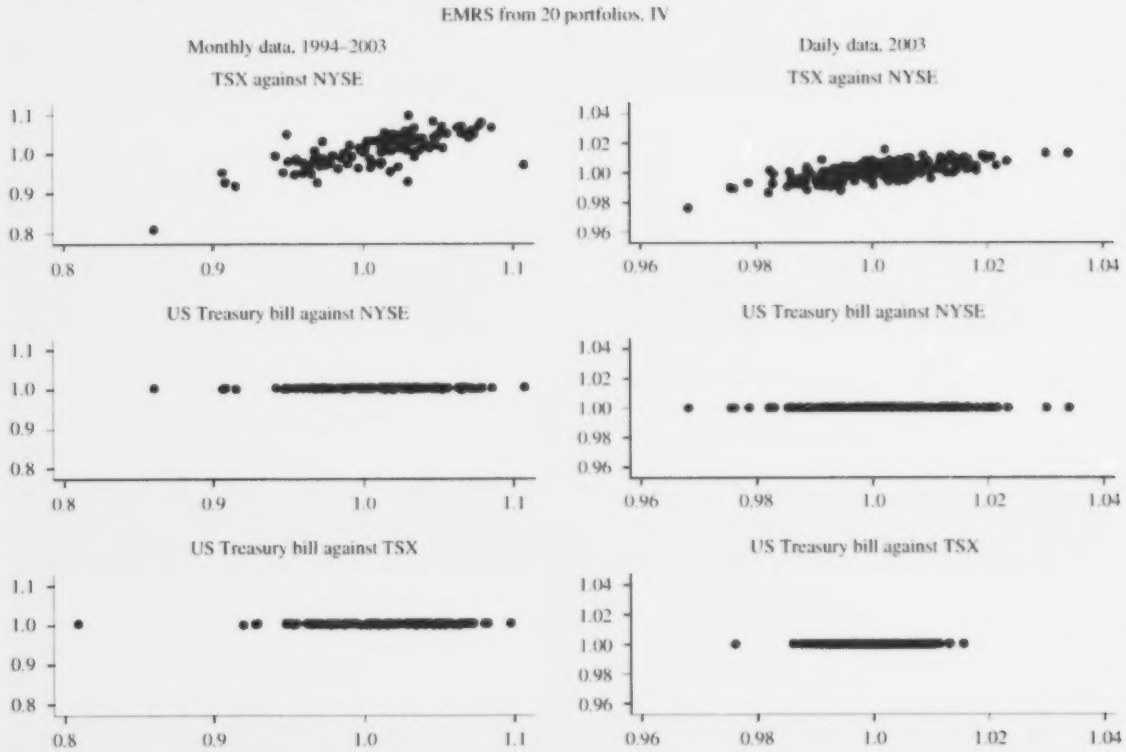
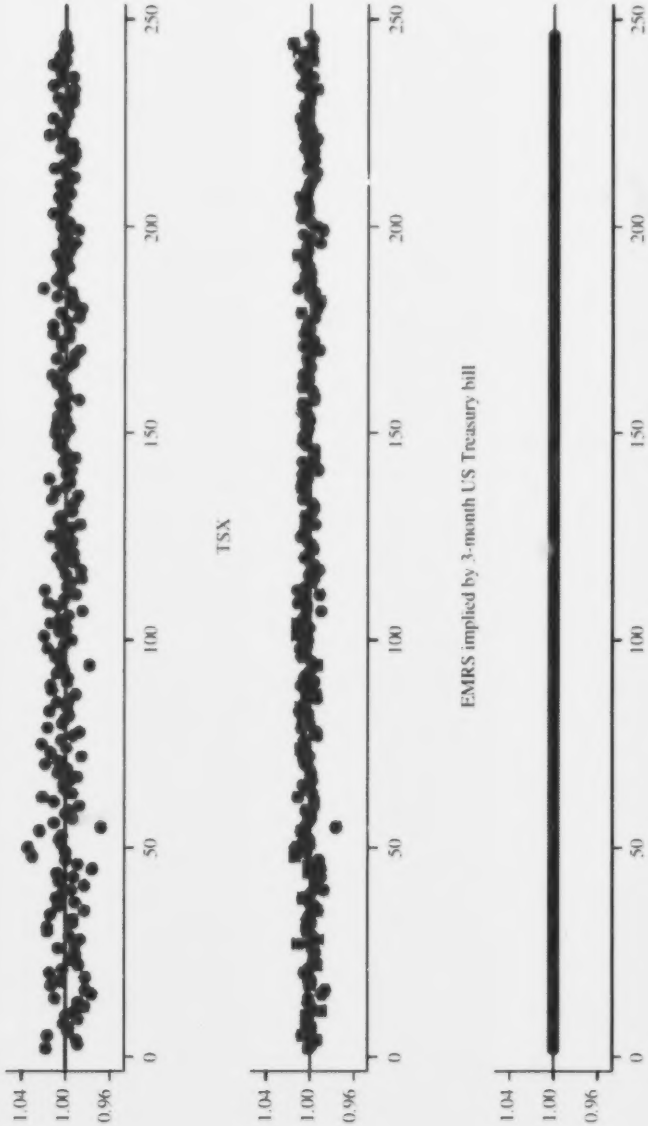


Figure 5
GMM daily estimates of EMRS, 2003

EMRS from 20 portfolios: GMM, daily data 2003 deltas, with +/-2 standard error confidence interval



In brief, the daily data set produces similar results to those of my monthly data set. The estimates of the EMRS seem intuitively reasonable, and display volatility consistent with that in the literature, but far in excess of the Treasury bill. While I can never reject the hypothesis of internal integration, I always reject the hypothesis of integration across markets in the sense of equal EMRS.

Conclusion

I have developed a methodology for estimating the EMRS that relies on exploiting the fact that idiosyncratic risk, which does not alter any risk premiums, should deliver a return equal to the market's expectation of the MRS. This enables me to estimate the expected risk-free rate from equity-price data. Comparing the rates estimated from different markets also provides a natural test for market integration, since integrated markets should share a common EMRS.

I apply the methodology to a decade of monthly data and a year of daily data, including data on stocks traded on the New York Stock Exchange and the Toronto Stock Exchange. For both data sets, I find intuitive estimates of the EMRS with reasonable means and considerable volatility over time. I cannot reject the hypothesis that markets are internally integrated in the sense that different portfolios traded on a given market seem to have the same EMRS. However, I find it easy to reject the hypothesis of equal EMRS across markets. This is of interest and would indicate that the technique has considerable statistical power.

There are many ways to extend the work. One could add a covariance model—e.g., the well-known factor model developed by Fama and French (1996)—to equation (8). A well-specified covariance model should result in more efficient estimates of the EMRS. Alternatively, one could sort stocks into portfolios in some systematic way (e.g., size, industry, or beta). More factors could be added to the first-stage regression, equation (9). While the use of the $\tilde{p}_t^j$ normalization has advantages, others might be used instead. One could test for excess returns that should be possible if EMRS diverges across markets, and if the EMRS is not equal to the Treasury bill rate. Most importantly, while I have been able to reject the hypothesis of integration in the sense of equal EMRS across markets, I have not explained the reasons for this apparent market segmentation. If my result stands up to scrutiny, this important task remains.

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Discussion

Eric Santor

The motivation for this paper is simple: to estimate the expected (intertemporal) marginal rate of substitution (EMRS). Deviating from most other papers in the literature that use some variation of Fama-French factors to explain asset returns, Rose develops a new, simple methodology. He then applies this methodology to test for market integration between US and Canadian equity markets. As a result, he is able to reject the hypothesis of market integration for the United States and Canada.

His methodology is straightforward. First, he estimates the returns to asset price j as a function of the average market-price growth:

$$\ln(p_t^j / p_{t-1}^j) = a_j + b_j \ln(\bar{p}_t / \bar{p}_{t-1}) + v_t^j, \tag{1}$$

where p_t^j is the price of asset j at time t, $\bar{p}_t$ is the average market price, a_j and b_j are fixed-regression coefficients, and v_t^j is an idiosyncratic shock. From these estimates, he constructs a "synthetic" price for each asset j.

$$\hat{p}_t^j \equiv p_{t-1}^j \times \exp\left(\hat{a}_j + \hat{b}_j \ln(\bar{p}_t / \bar{p}_{t-1})\right) \tag{2}$$

Using this synthetic price, the EMRS is estimated from the following equation:

$$x_{t+1}^j / \hat{p}_t^j = \delta\left(p_t^j / \hat{p}_t^j\right) + u_{t+1}^j, \tag{3}$$

where x_{t+1}^j is the income received by the owners of asset j and u_{t+1}^j is the error term. The estimate of δ is the EMRS. Not surprisingly, the estimate of δ depends heavily on the estimated synthetic price.

The model is taken to the data using daily returns from 2003 and monthly returns from 1994–2003 for the Standard and Poor 500 (S&P 500), NASDAQ, and the Toronto Stock Exchange (TSX). The monthly data cover 389 US firms and 152 Canadian firms, and the daily data cover 440 US firms and 223 Canadian firms. The data for Treasury bills are taken from the Federal Reserves' website. The estimation of equation (3) using instrumental variables produced reasonable measures of EMRS. Using these estimates, Rose then tests for market integration. If the measures of EMRS differ across markets, then market integration can be rejected. He finds evidence of integration between the S&P 500 and NASDAQ. However, he rejects integration between the S&P 500 and Treasury bills. Most importantly, he rejects the hypothesis of market integration between the S&P 500 and the TSX. Rose's results are compelling evidence that full integration between the US and Canadian equity markets has yet to occur. However, I have a number of concerns regarding the methodology.

The first is that to compare returns, the Canadian returns are converted to US-dollar returns using the contemporaneous Can$/US$ exchange rate. But could exchange rate effects drive a wedge between the respective EMRSs? For instance, if a common factor affects asset prices in the US and Canadian markets, would this factor also affect the exchange rate in a non-random manner? If movements in the exchange rate are correlated to asset-price movements, this could drive a wedge between the respective measures of EMRS.

My second concern is the assumption of the US investor. It is possible that US investors have different preferences from other investors. More generally, should we expect that the EMRS be equivalent across markets? Most likely, there is considerable investor heterogeneity, which implies that there will be differences in preferences over risk. It is not clear, therefore, that this simple test of market integration is appropriate.

My third concern relates to the methodology of constructing the synthetic price. First, does the model matter? Would the inclusion of Fama-French factors improve the model's efficiency? And should one include exchange rate risk? Second, the results depend on the use of instrumental variables. Does the market-wide average price satisfy the conditions of a valid instrument? Showing first-stage results would be helpful in this regard.

The test of market integration relies on the notion that the portfolios used to estimate the EMRS for each market are comparable. But could heterogeneity in the sample portfolios bias the results? The problem of heterogeneity may be particularly acute in the case of Canada, since there are a large number of family-owned firms listed on the TSX (typified by dual-class share structures) relative to the New York Stock Exchange

(NYSE). A possible solution to this problem of sample portfolio heterogeneity is to consider only Canadian firms that are cross-listed on the NYSE. In a similar vein, estimation of the EMRS may be biased owing to heterogeneous treatment effects. That is, common factors may affect different types of firms differentially. To account for heterogeneity in the sample portfolios, the author could consider a matching-methods approach. This would help to control for sample bias, which may in turn affect the estimation of the EMRS across the two samples.

In conclusion, Rose provides a simple and novel means for estimating EMRS, which is important, given its central role in many macroeconomic and finance models.

Is There a Quantity Puzzle Within Countries? An Application Using US and Canadian Data

*Jean Imbs**

Introduction

The "quantity puzzle" is a theoretical anomaly, because the presence of trade in financial assets should be motivated by insurance motives, which, in turn, should be reflected in quantities. Regions with particularly idiosyncratic local production patterns offer especially advantageous risk-sharing possibilities to each other and, therefore, have a particular incentive to consume out of an identical portfolio. In other words, consumption plans should be highly correlated between regions where fluctuations in local production are dissimilar, controlling for the possibility that capital flows be constrained institutionally. As is well known, the ranking in international data goes the opposite way.

In this paper, intranational data are brought to the issue. We ask whether fluctuations in disposable income (or retail sales) and output between US states and Canadian provinces give rise to a similar puzzle. They do not. We find that pairwise correlations in disposable income (or sales) are higher on

* Parts of this paper were written while the author was visiting the Institute for International Economic Studies at Stockholm University, whose hospitality is gratefully acknowledged. Thanks are due to Bent Sørensen for making his data on retail sales available to me. I am particularly grateful to Tamara Gomes at the Bank of Canada for diligently putting up with my relentless data requests. All errors are mine.

average than output correlations in the universe formed by the states and provinces of the United States and Canada. Most importantly, within countries, bilateral risk sharing tends to be associated with low output correlations, as theory suggests it should. This stands in stark contrast with cross-country evidence, where fluctuations in GDP are high between financially integrated economies. This suggests that the positive association between financial linkages and co-movements in GDP is the reason for the quantity puzzle, as documented in Imbs (2004b), and it is specific to international data.

The jump from international to intranational data is not straightforward. First, states or provinces within a federation benefit from federal transfers, which may aim at achieving some form of income insurance. As a result, local disposable income should be measured net of (positive or negative) transfers if it is to be indicative of the local propensity to engage in risk sharing. Second, regional output fluctuations embed the influence of both aggregate and local shocks. But financial flows within countries can aim only at insuring against region-specific shocks, irrespective of aggregate developments. The extent of local risk sharing is measured equally well whether or not aggregate shocks are controlled for.

Third, the quantity puzzle pertains to aggregate consumption, but tests of risk sharing in local data are typically based on disposable income. Unlike Canada, the United States does not report consumption at the state level, but only net disposable income. This complicates the comparison between the two levels of aggregation. Indeed, disposable income embeds savings rates, which could push upwards pairwise correlations in local disposable income. But it does not affect the responsiveness of output correlations to measured risk sharing, which appears to be consistent with theory within the United States and Canada, but not, more generally, across countries. In addition, we use information on retail sales at the state level as an alternative to disposable income in the United States.

While there are several available measures of international financial integration, the equivalent within countries is virtually uncharted territory. This paper extends standard measures of local risk sharing to a bilateral context. In particular, Kalemli-Ozcan, Sørensen, and Yosha (2001, 2003) and Asdrubali, Sørensen, and Yosha (1996) measured local risk sharing by the extent of income insurance, captured by the responsiveness of local disposable income to local production. Here, we measure the responsiveness of pairwise differences in disposable income to pairwise output gaps. Between financially integrated regions, the difference in disposable income should be independent of the realization of shocks to output in both regions. Between autarkic regions, on the other hand, discrepancies in the income

available for consumption are fully accounted for by differences in realized output. We implement this proxy to both international and intranational data, and show that the results across countries are similar to those implied by effectively observed measures of financial integration.

The paper follows the empirical methodology spelled out in Imbs (2004a, 2004b) and borrows from the extensive literature investigating the determinants of business cycle co-movements, on the one hand, while seeking to provide empirical estimates of the extent of risk sharing, on the other. It also leaves open the possibilities that trade, finance, and specialization are interrelated in ways that can affect the observed correlations in quantities. Section 1 details the data and measurement strategy. Estimations and results are presented in section 2, and the final section concludes.

1 Data and Measurement

1.1 International data

The international data used here are relatively standard and purport to reproduce the results documented in Imbs (2004b). Pairwise correlations in output and consumption are computed on the basis of yearly real GDP and aggregate consumption as reported in Version 6.1 of the Penn World Tables. Financial integration is measured as the pairwise sum of bilateral asset holdings reported in the Coordinated Portfolio Investment Survey (CPIS) conducted by the International Monetary Fund (IMF) in 2001. As an alternative, the paper also uses the restrictions indexes published in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions. They are summed pairwise, and the proxy reports the average number of countries with restrictions to financial flows, for each country pair.

The determinants of business cycle co-movements are standard. Bilateral trade flows are taken from the IMF's Direction of Trade Statistics database, and computed in an intensive form following Deardorff (1998), Clark and van Wincoop (2001), and Imbs (2004a, 2004b):

$$T_{ij} = \frac{1}{T}\sum_t \frac{(EX_{i,j,t} + IM_{i,j,t}) \cdot NYW_t}{NY_{i,t} \cdot NY_{j,t}}.$$

$EX_{i,j,t}(IM_{i,j,t})$ denotes total merchandise exports (imports) from country i to j in year t, NY_i denotes nominal GDP in country i, and NYW is world nominal output. Following Clark and van Wincoop (2001) and Imbs (2004a,

2004b), sectoral real value-added data are used to compute an index S of the similarity in sectoral structure:

$$S_{ij} = \frac{1}{T}\sum_{t}\sum_{n}^{N}\left|s_{n,i} - s_{n,j}\right|,$$

where $s_{n,i}$ denotes the GDP share of industry n in country i. S_{ij} is the time average of the discrepancies in economic structures of countries i and j, and reaches its minimal value zero for two identical countries.[1] The sectoral shares s are computed using one-digit value-added data covering all sectors of the economy, from the United Nations Statistical Yearbook. Combining all data sources and constraints gives rise to a database comprising a maximum of 63 countries, or 1,953 pairwise combinations. All details on the international data can be found in Imbs (2004b).

1.2 Intranational data

This paper aims at asking from intranational data the same question Imbs (2004b) asked from international data, with focus on the impact of financial integration on output correlations. It is, therefore, important that the estimation in this paper be as close as possible to the standard international approach, with the implied data requirements. Most of the data on US states are taken from the Bureau of Economic Analysis (BEA). Yearly series on real gross state product (GSP) run from 1986 to 2000, while yearly data on state disposable income, net of taxes, run from 1969 to 2001. The data on disposable income are deflated using the same state-level deflator used to obtain real GSP series. The BEA also reports time series on total transfer receipts at the state level, from 1969 to 2001. These include retirement insurance; medical payments; family assistance, such as food stamps; and unemployment insurance. Local disposable income is measured net of taxes and all personal transfers. This residual is taken to reflect decentralized risk-sharing decisions.

There are issues of comparability. State-level information on consumption is not available for the United States, although it exists for the ten Canadian provinces and one territory. Unfortunately, such reduced coverage remains insufficient to draw general (or even significant) conclusions using intranational data. As a result, most existing studies have focused on disposable

1. Both the trade and specialization measures are based on time averages. Results do not change if initial values are used instead.

income data.[2] We do so here, as well, but we also use disaggregated measures of retail sales as an alternative measure of consumption behaviour.

None of this is an issue for the purpose of estimating the extent of local income insurance, but pairwise correlations in disposable income are not immediately comparable with pairwise correlations in aggregate consumption.[3] International correlations in net national income (NNI) would be the aggregate equivalent, but these, in turn, cannot easily relate to the quantity puzzle and are of less interest as a result. Furthermore, NNI is available for a relatively limited sample of countries, and the approach would truncate sizably the international dimension of the exercise. As a result, this paper compares the pairwise correlations in disposable income (or retails sales) and in local production as a test of the quantity puzzle in disaggregated data. How this affects the generality of the conclusions is discussed later.

Interstate trade flows are taken from the Commodity Flow Survey conducted by the US Bureau of Transportation in 1993 and 1997. The data are used to compute T_{ij} according to the definition used in the international context. The two observed years are averaged, but results are unchanged if using either one in isolation. State-level patterns of production are reported by the BEA from 1986 to 2000. Information is available for 62 sectors, and it is used to compute S_{ij} for each state. Population by state and other gravity variables used as instruments are also available from the BEA, or otherwise obtained from public sources.[4]

Most of the information on Canadian provinces comes from Statistics Canada's CANSIM database.[5] Series on real gross product per province run from 1984 to 2003. Real consumption is available from 1984 to 1996, and is deflated with the same index as real output. Interprovincial trade flows are available from 1981 to 2002, and are used to compute T_{ij} as an average over the whole period. S_{ij}, in turn, is computed using sectoral data specific to each province, available at the equivalent of a two-digit level of aggregation between 1984 and 2000. Results using initial values instead for both T_{ij} and S_{ij} are virtually identical. As for the US data, distance and other gravity variables are obtained from public sources.

2. See, for instance, Kalemli-Ozcan, Sørensen, and Yosha (2003).
3. They should, however, be equal under perfect income insurance.
4. For instance, the bilateral distances between state capitals is readily available on the Internet.
5. The sample includes: Newfoundland, Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia, and the Northwest Territories. Nunavut is not included because of insufficient time coverage.

Of prominent interest is a measure of financial integration between economic regions in the same country, which is not directly observable. Kalemli-Ozcan, Sørensen, and Yosha (2001, 2003) and Asdrubali, Sørensen, and Yosha (1996) introduced a proxy based on the responsiveness of local income to local production. In particular, for each US state, they estimated

$$y_{it} - d_{it} = \alpha + \beta y_{it} + \varepsilon_{it}, \tag{1}$$

where y_{it} denotes (the cyclical component of) output in region i, and d_{it} is (the cyclical component in) local net disposable income. β is an index of risk sharing in region i. As financial openness unhinges income from local production, local disposable income becomes idiosyncratic and unrelated to y_{it}, and β equals unity. At the other extreme, financial autarky means that local income is fully determined by local output, the dependent variable in equation (1) becomes white noise, and $\beta = 0$.

β provides an estimate of overall risk sharing in region i, but cannot be used directly in a bilateral context. The pairwise sum of β, for instance, is a noisy—and worse, potentially misleading—proxy for bilateral financial integration. Alaska and Texas could, for example, engage in financial transactions meant to limit income fluctuations in both states, whose production is specialized and thus potentially volatile. So, $\beta_i + \beta_j$ will tend to be high between regions that might be sharing risk with different third parties, rather than with each other. Indeed, effective risk sharing between the two states might well be virtually nonexistent, since they provide poor insurance possibilities for each other, as they both specialize in oil industries and may have highly correlated GSP as a result.

This paper follows the same intuition, using observed fluctuations in output and disposable income (or retail sales) to measure the extent of financial integration. But the estimation in equation (1) is extended to make it applicable to a bilateral context. In particular, we estimate

$$\Delta y_{ijt} - \Delta d_{ijt} = \alpha + \beta \ \Delta y_{ijt} + \varepsilon_{ijt}, \tag{2}$$

where Δx_{ijt} denotes differences in x_t between regions i and j. According to equation (2), capital flows from a region with high relative output into one with low relative output, with the purpose that fluctuations in disposable income (i.e., consumption) be equated across regions. Whether this is possible is measured by β, which captures the extent to which Δd_{ijt} is white noise in equation (2). Now, the possibility that Alaska and Texas choose to insure income with third parties rather than with each other is accounted for through the presence of the output-gap term, Δy_{ijt}. Estimates of β are now low, as they should be, between regions that offer little insurance motive to each other (y_{it} and y_{jt} move in lockstep), even when

measured fluctuations in income are similar because of risk sharing with third parties (say, New York). The validity of the approach in equation (2) is verified in the international data set, comparing results implied by estimates of β to those implied using directly observable measures of bilateral financial integration.

Estimates for β in equation (2) will tend to be high if Δd_{it} tends to remain constant over time and Δy_{it} does not, i.e., when risk sharing as measured by relative variations in disposable income is also warranted on grounds of measured variations in relative output. In other words, estimates for β tend to be high if consumption correlations are high and output correlations are low, which potentially creates a positive bias between β and pairwise correlations in consumption. That makes it impossible to use this paper's approach to investigate the effect of financial integration on consumption plans between regions within one country, where β is the only available proxy. But Imbs (2004b) showed that, across countries, the main theoretical anomaly pertains to the association between output correlations and financial integration, negative in theory yet positive in international data. As Lewis (1996) already showed, consumption plans are detached from available production to an extent that increases with financial flows, as predicted by theory, and their behaviour is therefore less of a puzzle.

This paper focuses on the correlation between estimates of β in equation (2) and bilateral output correlations. *Ceteris paribus*, β tends to be low between regions with correlated output (since they provide little opportunity for risk sharing), which potentially induces a negative bias in the relation this paper seeks to evaluate. But, as will become clearer, the paper stresses the difference between results at the international and intranational levels. That discrepancy cannot be ascribed to an attenuating bias that presumably prevails equally in both data sets.

2 Estimations and Results

This section introduces the paper's main estimations, inspired largely from Imbs (2004b), and presents the main results. We first report simple results pertaining to output correlations, then complicate the approach to allow for interrelations between the determinants of business cycle correlations. The section closes with extensions and robustness checks.

Table 1 summarizes the statistics of interest in both data sets. In particular, it reports the moments of pairwise correlations in output, consumption, disposable income, and retail sales, as well as the main characteristics of the estimates of β in international and intranational data. Several comments are in order. First, β is, on average, larger within than between countries,

Table 1
Summary statistics

	International data			Intranational data		
	Mean	Min.-Max.	Obs.	Mean	Min.-Max.	Obs.
Output correlations	0.0822 0.215	−0.566/0.782	1,770	0.2104 0.339	−0.816/0.952	1,341
Consumption correlations	0.0292 0.198	−0.539/0.847	1,770	0.4327 0.308	−0.720/0.938	1,330
Sales correlations				0.2733 0.355	−0.813/0.981	1,330
Risk-sharing index	0.1487 0.278	0/1.575	1,830	0.4418 0.423	0/2.029	1,330
Risk-sharing index (sales)				0.6421 0.973	0/6.582	1,330

Notes: All variables are computed using the cyclical components of output and consumption as implied by the Baxter and King (1999) filter, with adequate parameters for yearly data. Real series for intranational data are obtained using regional GSP deflators. Consumption is net of taxes and transfers. "Mean" reports both the cross-sectional average and the corresponding standard error.

regardless of whether it is estimated using income or sales data. This is consistent with findings in Kalemli-Ozcan, Sørensen, and Yosha (2003) that risk sharing tends to be larger within regions of the same country than between countries, although β here pertains to income insurance between pairs of regions, rather than multilateral risk sharing. Second, output correlations are larger on average than consumption correlations between countries, an illustration of the quantity puzzle. Third, within the same country, regional output co-movements tend to be much lower than co-movements in local disposable income. This indicates that things might be different within countries, at least in North America. The results in Imbs (2004b) suggested that financial integration pushed both international correlations in output and in consumption upwards. Therefore, the fact that there appears to be more risk sharing between the regions of a same country cannot account for the smaller gap between the two interregional correlations in Table 1, unless the results in Imbs (2004b) do not apply to intranational data. This paper determines whether this is the case.

Two caveats are in order. First, pairwise correlations in disposable income embed regional savings rates, which could push them upwards relative to bilateral correlation in consumption. The smaller discrepancy implied by retail sales data is consistent with this possibility. The gap between output and consumption correlations may be thinner for intranational data than Table 1 suggests. Second, the cross-sectional variation in all pairwise correlations is such that none of the claims just described is significant.

Such variation is what makes these cross-sections potentially informative for rigorous inference.

2.1 The correlations in output

We know little about the relationship between financial integration and cycle synchronization.[6] Most theoretical models predict that it should be negative, starting with Backus, Kehoe, and Kydland (1994). Under complete markets, capital flows into the economy hit by a positive technology shock, and away from the no-shock economy, and thus between economies that tend to be out of phase. Limited enforcement introduced in Kehoe and Perri (2002) endogenously limits the magnitude of international capital flows, but does not alter the general result that, if capital flows between two regions, they should tend to be asynchronized. Empirically, this negative link has proved to be elusive. Kose, Prasad, and Terrones (2003); Bordo and Helbling (2003); and Imbs (2004b) all conclude that if anything, financially integrated countries have positively correlated output fluctuations. An exception is Heathcote and Perri (2002), who explain the falling correlation between the US economy and an aggregate of the rest of the world with increased financial integration.

We know much more about other determinants of the international correlations in GDP fluctuations. Since Frankel and Rose (1998) found a large and significant effect of bilateral trade intensity on business cycle co-movements, many papers have concerned themselves with the relative importance of trade, finance, and other potentially important variables. To name a few, Imbs (1999); Clark and van Wincoop (2001); or Kalemli-Ozcan, Sørensen, and Yosha (2001) document a significant impact of specialization patterns. Alesina, Barro, and Tenreyro (2002) or Rose (2000) focus on currency unions. Imbs (2004a) and Baxter and Kouparitsas (2004) assess the relative magnitude of these channels.

This paper focuses on the link between financial integration and business cycle co-movements within the United States and Canada. We know since Imbs (2004b) that financial integration tends to be associated with correlated GDP fluctuations. We now ask whether this is true between regions in North America, as well. To do this, we follow Imbs (2004b) in estimating jointly

$$\rho_{ij}^{Y} = \alpha_0 + \alpha_1 \ \phi_{ij} + \alpha_2 \ T_{ij} + \alpha_3 \ S_{ij} + \alpha_4 \ X_{ij} + \varepsilon_{ij}^{0}$$

6. This review summarizes the detailed discussion in Imbs (2004b).

$$T_{ij} = \gamma_0 + \gamma_1 \ \phi_{ij} + \gamma_2 \ I^1_{ij} + \varepsilon^2_{ij} \qquad \text{(S)}$$

$$S_{ij} = \delta_0 + \delta_1 \ \phi_{ij} + \delta_2 \ I^2_{ij} + \varepsilon^3_{ij},$$

where ρ^Y_{ij} denotes the Pearson correlation between the cyclical components of GDP in regions i and j, and ϕ_{ij} is a measure of bilateral financial integration. X_{ij} is a vector of control variables that affect ρ^Y_{ij} directly. Any direct impact of finance on cycles is captured by estimates of α_1. In this general specification, it is possible that financial integration affects trade, via γ_1, or indeed specialization, via δ_1. The first channel reflects the possibility that trade and financial flows build on the same stock of local knowledge or infrastructures, as argued, for instance, in Lane and Milesi-Ferretti (2004). The second channel corresponds to the potential specialization effects of finance that Kalemli-Ozcan, Sørensen, and Yosha (2003) documented. We first estimate a version of the system (S), where γ_1 and δ_1 are set to zero, then generalize the estimation.

Identification of the system (S) requires distinct instrument sets for T_{ij} and S_{ij}, which are relatively standard. The gravity model of international trade justifies the use of geographic variables to instrument T, as they are both obviously exogenous and strong predictors of trade flows. Specialization is less easy to instrument. We follow Imbs (2004b) and instrument S with both the pairwise sum and difference of per capita output, which assumes that rich regions tend to be more diversified, and thus potentially more similar.

This choice for I^1, I^2 enables identification of the system (S) and also tackles issues of endogeneity, for instance of T to ρ^Y. But it leaves open the question of the endogeneity of ϕ_{ij}. In international data, we follow Imbs (2004b) and instrument observed financial integration from the CPIS data with institutional variables capturing the financial advancement of both countries. But the same cannot be achieved at the intranational level, for lack of comparable data between regions in the United States or Canada. It is important, however, to reiterate that the endogeneity of ϕ_{ij} creates an attenuating bias, as synchronized economies should have low values of ϕ_{ij}. This paper compares results in two data sets where the endogeneity of ϕ_{ij} is likely to prevail equally. The impossibility of coming up with instruments for ϕ_{ij} for US states and Canadian provinces cannot explain that these data generate different results from aggregate ones.

2.2 Results

Table 2 reports ordinary least squares regression of the system (S) where γ_1 and δ_1 are set to zero, which, de facto, shuts down all simultaneity

Table 2
The determinants of output correlations

	International data			Intranational data		
	(i) OLS	(ii) IV	(iii) IV	(iv) OLS	(v) IV	(vi) IV
Trade	0.0451	0.2295	0.0540	0.0022	0.0127	0.0157
	2.68	4.99	1.93	0.39	1.58	1.86
Structure	−0.3800	−0.4313	−1.2328	−0.8475	−0.4427	−0.5556
	−4.86	−2.65	−9.78	−9.98	−3.00	−3.63
Finance	0.0036	0.0136	0.1414	−0.1170	−0.1238	−0.0210
	2.98	6.13	4.70	−3.93	−4.25	−1.74
Obs.	465	274	778	643	643	643

Notes: The dependent variable is the bilateral correlation in the cyclical components of output. Specifications (i) and (ii) use directly observed measures of bilateral asset holdings collected by the IMF for 2001, and sums the values of all asset holdings in both directions. Specifications (iii)–(vi) use instead the proxy based on bilateral risk sharing, constructed on the basis of the cyclical component of real consumption (iii), real disposable income (iv) and (v), and real retail sales (vi). All series are detrended using the Baxter-King (1999) filter. The instruments for trade include distance, a binary variable capturing the presence of a common border, and the product of populations. The instruments for structure include the sum and pairwise differences in per capita output, and the instruments for finance (when it is directly observed) capture financial development in each economy, and include an index of accounting standards, a measure of the efficiency of the judicial system, whether votes at general meetings are cast cumulatively or proportionately, and the risks of expropriation and contract repudiation.
OLS: ordinary least squares.
IV: instrumental variable.

problems. In the international data, specifications (i) and (ii) make use of the CPIS data on bilateral asset holdings, instrumented in (ii). All other specifications use proxies for ϕ_{ij} given by the estimates of β in equation (2). Finally, estimations (iii) and (v) instrument trade and structure. In both data sets, the impact of trade and structure is consistent with results in the literature: intense bilateral trade linkages are associated with correlated business cycles, whereas economies with similar patterns of specialization are more correlated.

The striking result in Table 2 pertains to the measured role of finance. Across countries, we confirm the conclusion in Imbs (2004b), that financially integrated countries are significantly more synchronized. This happens whether ϕ_{ij} is measured using the IMF CPIS data, whether bilateral asset holdings are instrumented or not, and when ϕ_{ij} is measured using this paper's suggested proxy, based on aggregate consumption data. Estimates of α_1 are in all cases positive and significant. This is particularly remarkable in specifications (i) and (iii), where ϕ_{ij} is not instrumented and the estimates of α_1 (potentially) suffer from an attenuating endogeneity bias. Consistent with this, instrumentation in column (ii) does indeed increase the magnitude

of α_1. Across regions within one country, on the other hand, α_1 is always negative and significant, whether T_{ij} and S_{ij} are instrumented or not, and whether β is estimated using disposable income or retail sales data. This suggests that the effect of financial integration on ρ_{ij}^{Y} is drastically different within the regions of a same country, and indeed potentially consistent with theory (though estimates for α_1 in columns (iv) to (vi) might not be as negative if we were able to instrument ϕ_{ij}).

An explanation for the difference might be that ρ_{ij}^{Y} has other determinants in international data (but not in intranational data) that we fail to control for properly. Most prominently, aggregate business cycles might correlate positively because of international coordination in macroeconomic policies, in turn possibly correlated with our measures of ϕ_{ij}. If this were true, it would already foster our understanding of the quantity puzzle, since it would mean that business cycles are more correlated than consumption plans across countries because of convergence in policy. That would not leave much of a puzzle, and intranational data would offer a vindication for existing theories of capital flows and their effect on business cycle synchronization. It is, however, far from clear that positive estimates for α_1 in international data stem from policy coordination. For instance, Imbs (2004b) controls for measures of exchange rate volatility, differentials in inflation rates, or the presence of monetary or trade unions, and still finds positive measures for α_1, even in a sample excluding correlations between rich OECD (Organisation for Economic Co-operation and Development) economies, the most likely to coordinate their policies. Kose, Prasad, and Terrones (2003) conclude similarly.[7]

Table 3 now allows for γ_1 and δ_1 to differ from zero. The main result is unchanged: α_1 is positive in international data, but negative in intranational data. This is important, for it suggests that α_1 is not negative in intranational data because of the specialization effects of finance, which might be more acute within than between countries. The putative effects of finance on trade

7. Another difference between the two data sets pertains to the series utilized when estimating β. In international data, actual consumption is used, whereas local disposable income is used in intranational data. The latter embed local savings rates. But for this to explain the discrepancy in Table 2, we would need the pairwise difference in savings rate Δs_{ijt} to correlate very negatively with Δy_{ijt}. In other words, we would need $s_{it} < s_{jt}$ whenever $y_{it} > y_{jt}$. It is impossible to verify this possibility in intranational data, but in the literature, savings rates are usually found to increase with income, rather than the opposite. Furthermore, our results are by and large confirmed by state-level sales data, which are immune from this potential issue.

Table 3
Simultaneous estimations

	International data		Intranational data	
	(i) 3SLS	(ii) 3SLS	(iii) 3SLS	(iv) 3SLS—Sales
Correlation equation				
Trade	0.2226	0.0539	0.0125	0.0104
	4.82	1.93	1.55	1.26
Structure	−0.3980	−1.2371	−0.4426	−0.4627
	−2.43	−9.81	−3.00	−3.07
Finance	0.0131	0.1180	−0.1228	−0.0225
	5.70	3.41	−4.08	−1.88
Trade equation				
Finance	0.0103	0.0000	−0.2332	−0.0324
	1.82	0.00	−1.73	−0.64
Specialization equation				
Finance	−0.0027	−0.0269	0.0132	0.0235
	−2.02	−1.49	1.07	5.20
Obs.	274	778	643	643

Notes: Specification (i) uses directly observed measures of bilateral asset holdings collected by the IMF for 2001, and sums the values of all asset holdings in both directions. Specifications (ii)–(iv) use instead the proxy based on bilateral risk sharing, constructed on the basis of the cyclical component of real consumption (ii), real disposable income (iii), and real retail sales, (iv). All series are detrended using the Baxter-King (1999) filter. The instruments for trade include distance, a binary variable capturing the presence of a common border, and the product of populations. The instruments for structure include the sum and pairwise differences in per capita output, and the instruments for finance (in column (i)) capture financial development in each economy and include an index of accounting standards, a measure of the efficiency of the judicial system, whether votes at general meetings are cast cumulatively or proportionately, and the risks of expropriation and contract repudiation.
3SLS: three-stage least squares.

or specialization are accounted for in Table 3. Estimates of the residual effect may still be affected by the endogeneity of ϕ_{ij}, but not in a way that can explain the discrepancy between intra- and international data.

2.3 Extensions and robustness

In this section, we extend the estimations to include measures of the size of the financial sector. We then close with some sensitivity analysis.

Table 4 reproduces Table 3, adding a measure of the size of the financial sector in the correlation equation. This is meant to control for the possibility that actual risk sharing as measured by ϕ_{ij} (or β) be determined by local regulations affecting financial development, as banking regulations in the

Table 4
The determinants of output correlations—FIRE

	International data		Intranational data		
	(i) 3SLS	(ii) 3SLS	(iii) 3SLS	(iv) 3SLS	(v) 3SLS—Sales
Correlation equation					
Trade	0.2452	0.0581	0.0220	0.0246	0.0196
	5.60	2.08	2.66	3.11	2.33
Structure	−0.3761	−1.2529	−0.3938	−0.6774	−0.41147
	−2.24	−9.03	−2.91	−4.71	−2.96
Finance	0.0150	0.1179	−0.1223	−0.1197	−0.0182
	5.88	3.41	−4.10	−3.94	−1.55
FIRE	−0.2401	−0.0563	0.5292		0.5105
	−1.19	−0.60	2.82		2.66
Bank				−4.6038	
				−7.52	
Securities				5.5806	
				5.61	
Real estate				0.5364	
				1.88	
Holdings				−11.1211	
				−1.72	
Insurance				3.3603	
				2.17	
Trade equation					
Finance	0.0100	−0.0006	−0.2308	−0.2311	−0.0330
	1.76	−0.01	−1.71	−1.71	−0.65
Specialization equation					
Finance	−0.0029	−0.0271	0.0133	0.0133	0.0235
	−2.19	−1.45	1.07	1.07	5.20
Obs.	274	778	643	643	643

Notes: Specification (i) uses directly observed measures of bilateral asset holdings collected by the IMF for 2001, and sums the values of all asset holdings in both directions. Specifications (ii)–(v) use instead the proxy based on bilateral risk sharing, constructed on the basis of the cyclical component of real consumption (ii), real disposable income (iii) and (iv), and real retail sales (v). All series are detrended using the Baxter-King (1999) filter. FIRE denotes the pairwise sum of the share of the finance, insurance, and real estate sector in overall output. The instruments for trade include distance, a binary variable capturing the presence of a common border, and the product of populations. The instruments for structure include the sum and pairwise differences in per capita output, and the instruments for finance (in column (i)) capture financial development in each economy, and include an index of accounting standards, a measure of the efficiency of the judicial system, whether votes at general meetings are cast cumulatively or proportionately, and the risks of expropriation and contract repudiation.
3SLS: three-stage least squares.

Table 5
The determinants of output correlations—sensitivity

	International data			Intranational data		
	(i) HP	(ii) T2	(iii) UNIDO	(iv) HP	(v) T2	(vi) T2—Sales
Correlation equation						
Trade	0.0792	49.069	0.0834	0.0119	5.2782	5.0206
	2.44	5.70	3.71	1.45	4.14	3.63
Structure	−1.2618	−0.6067	−0.5582	−0.4509	−0.0403	−0.0611
	−8.83	−3.65	−12.21	−3.00	−0.24	−0.35
Finance	0.0786	0.0612	0.1002	−0.0659	−0.1260	−0.0310
	2.01	1.83	4.86	−1.67	−4.22	−2.61
Trade equation						
Finance	−0.0022	0.0012	−0.4779	0.2103	−0.0025	−0.0008
	−0.03	2.73	−0.81	1.21	−2.72	−2.30
Specialization equation						
Finance	−0.0329	−0.0337	−0.0183	−0.0196	0.0130	0.0235
	−1.76	−1.80	−0.98	−1.23	1.05	5.21
Obs.	778	778	1,491	643	643	643

Notes: All specifications use the proxy based on bilateral risk sharing, constructed on the basis of the cyclical component of real consumption (i) to (iii), real disposable income (iv) and (v), and real retail sales (vi). Specifications (i) and (iv) use the HP filter to isolate the cyclical component of time series when estimating β in equation (2). Specifications (ii), (v), and (vi) use an alternative measure for bilateral trade intensity, where exports and imports are normalized by both regions' total output. Column (iii), finally, uses a measure of S based on manufacturing data from the United Nations Industrial Development Organization (UNIDO). The instruments for trade include distance, a binary variable capturing the presence of a common border, and the product of populations. The instruments for structure include the sum and pairwise differences in per capita output.
T2 denotes the alternative measure of bilateral trade intensity used in Frankel and Rose (1998).

United States, for instance. Different outcomes at both levels of aggregation could then merely reflect different regulations of the financial sector within and between countries. Table 4 ensures they do not: estimates for α_1 continue to change signs with the level of aggregation, whether or not the (pairwise sum of the) shares of the finance, insurance, and real estate (FIRE) sector in overall output are controlled for. Interestingly, Table 4 also suggests that US states and Canadian provinces that have developed FIRE sectors tend to be more correlated, a result that does not hold significantly between countries. A decomposition of the FIRE sector suggests that this happens mostly because of the securities, insurance, and real estate sectors. In contrast, the prevalence of a large banking sector seems to be associated with low output correlations.

Table 5 conducts a sensitivity analysis. First, an alternative filter is used to isolate the cyclical component of output and to estimate β in equation (2). Second, an alternative measure of bilateral trade intensity is used, following

Frankel and Rose (1998), which consists in the sum of bilateral exports and imports simply normalized by both regions total output. Third, for international data, the UNIDO data are utilized to compute S on the basis of manufacturing production only. The results obtain in all cases. α_1 continues to change signs with the level of aggregation.

Conclusion

This paper uses intranational data on the United States and Canada to investigate the determinants of output correlations at the regional level. An important difference with the international evidence is uncovered. While financial integration tends to result in synchronized business cycles in the aggregate, the opposite is true within countries, at least in the United States and Canada. A novel proxy for bilateral risk sharing between regions is proposed to obtain this result. This specificity of intranational data may explain why, in the United States and in Canada, correlations in disposable income are larger than correlations in output, in contrast with the aggregate evidence. In regional data, the link between bilateral financial integration and output correlations is consistent with theory. There is no apparent quantity puzzle. This suggests that the key to the puzzle in aggregate data lies in understanding the determinants of aggregate capital flows and, in particular, why they tend to result in positively correlated business cycles.

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Discussion

Linda Goldberg

My discussion will focus on two areas—on the paper by Jean Imbs, and on understanding the institutions that may be contributing to the quantity puzzle. I will use as an example the role of banks in fostering real effects of financial integration. Banks are useful institutions for this purpose, since we can consider what their mechanisms for consumption smoothing would be, if they were involved in such smoothing. As a general comment on the quantity puzzle research agenda, I would like to see more discussion of which institutions are expected to participate in the type of insurance mechanism implicit in the quantity puzzle. More institutional and data details would be useful in this respect.

The paper by Jean Imbs is a useful study with carefully implemented empirics. It begins with a relationship that has surprised many economists. Specifically, while consumption is less correlated than business cycles across countries (the quantity puzzle), consumption is more correlated than business cycles across regions. Imbs offers an explanation whereby the specific impact of capital flows on international output correlations is behind the quantity puzzle. In other words, he posits that capital flows don't provide insurance internationally, but may do so intranationally (i.e., within a country's borders).

The paper is part of a large body of literature on intranational risk sharing. Within this literature, studies of US states emphasize the roles played by capital markets and/or fiscal federal systems: as in Atkeson and Bayoumi (1993); Asdrubali, Sørensen, and Yosha (1996); Athanasoulis and van Wincoop (2000); and Sala-i-Martin and Sachs (1992). There are also studies of Canadian provinces that emphasize the explicit mechanism for horizontal transfers among the provinces, i.e., the Canadian system of equalization

(redistribution instead of insurance per se). Examples are Bayoumi and Masson (1995), Mélitz and Zumer (1999), and Obstfeld and Peri (1998). More recent papers focus on the importance of trade linkages.

Imbs argues that financial integration helps with risk sharing in Canadian provinces and in US states. But financial integration between economic regions in the same country is not directly observable. A proxy is introduced based on the responsiveness of local income to local production. While such a proxy has been used in other studies (mostly international), I find it less than compelling within a country, since the proxy can capture many things other than financial integration. It would be useful, therefore, to determine and more precisely document why financial institutions might behave differently within rather than across countries.

Do banks smooth consumption internationally? To explore this question, let us consider a real application. Specifically, how should we think about what real effects are associated with financial integration through banking? Consider two types of foreign exposures of banks: cross-border claims (claims on foreign debtors by US domestic banks) and local claims (claims on foreign debtors by branches of US banks located in the debtor's country). Figure 1 shows the total cross-border claims of US reporting banks starting in 2000 and continuing through mid-2004, and provides details on the components for Europe, Asia, and Canada.[1] Note that in total cross-border lending by the United States, Canada is the recipient of $26 billion (only 4 per cent of nearly $693 billion in 2004).

Data on foreign exposures of US banks, this time focusing on net local country claims by US banks, reveal a different pattern. As shown in Figure 2, Canada is the recipient of $17.6 billion of net local country claims by US reporting banks, approximately 20 per cent of $85.8 billion in 2004. These data suggest that in banking, US banks have more financial integration through local affiliates than through cross-border flows.

Figure 3 shows these two types of claims, normalized so that 2004Q1 = 100, plotted alongside normalized Canadian real GDP and US real GDP. It appears that both types of claims are procyclical with Canadian GDP, as is typical for bank lending. If this is the case, it is difficult, ex ante, to show that banks are playing a large role in international consumption smoothing. At the very least, Imbs and other researchers on the quantity puzzle should provide a much more nuanced explanation of which types of flows and to which types of parties would be the appropriate metrics for

1. Data are from the Federal Financial Institutions Examination Council (FFIEC) quarterly report: E.16 Country Exposure Lending Survey and Country Exposure Information Report, Table 1.

Figure 1
Total cross-border claims of US reporting banks

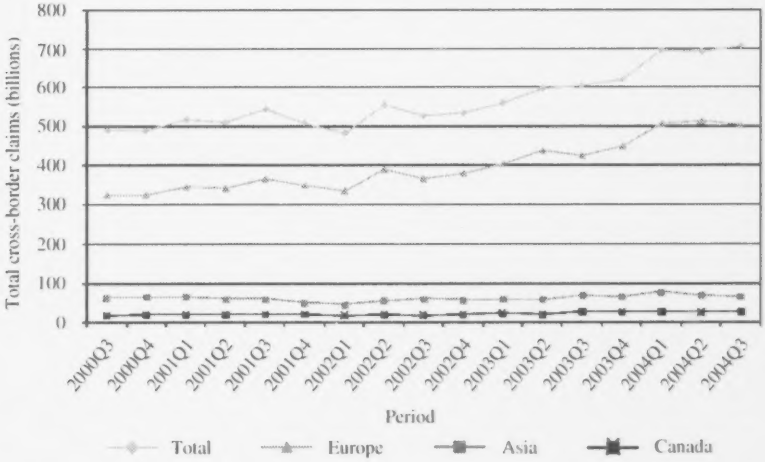


Figure 2
Net local country claims of US reporting banks

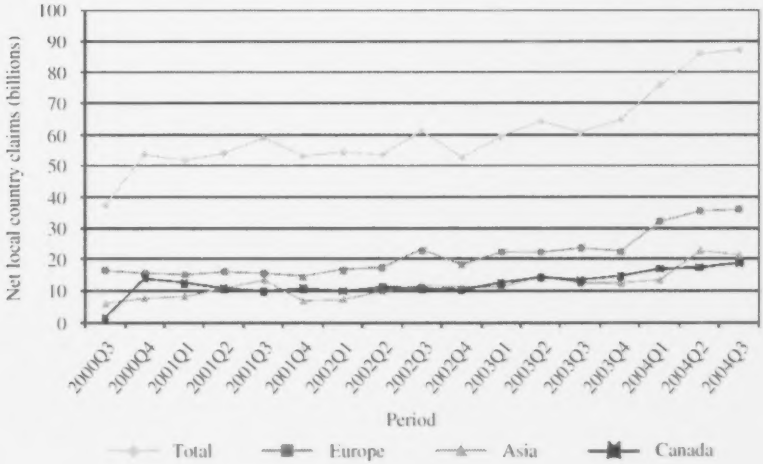
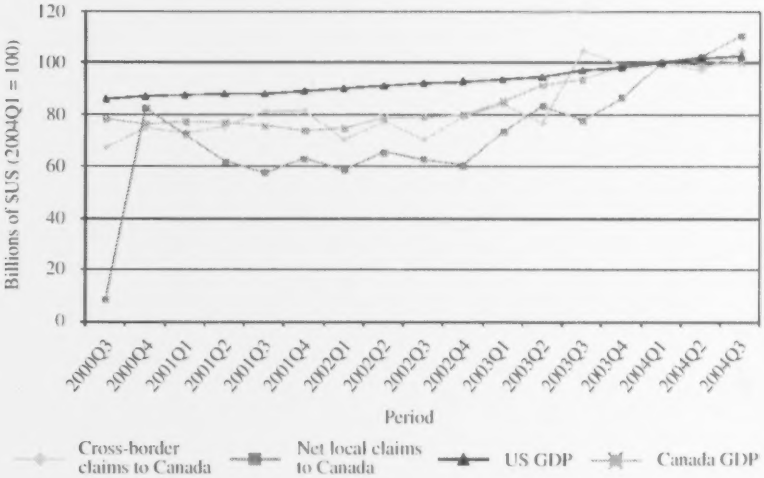


Figure 3
US reporting banks claims to Canada, with GDP data

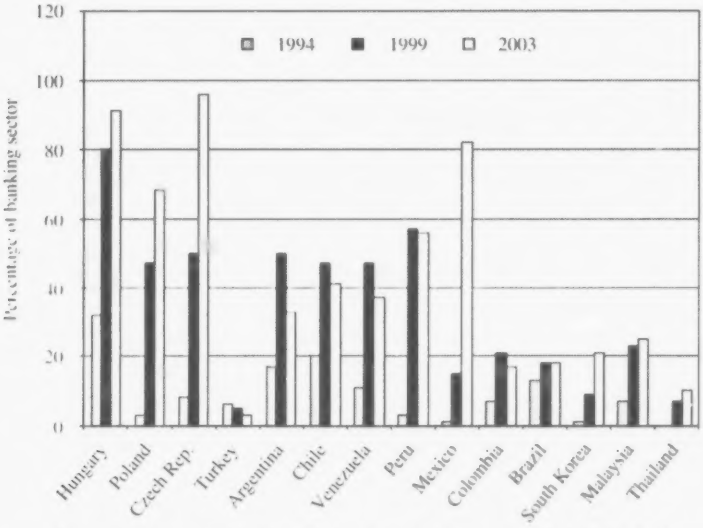


discussions on consumption smoothing. This type of observation has been made for Canada and other industrialized countries, but it also applies to emerging economies.

It is also interesting to think about whether the changing structure of the industrialized country banks within, for example, emerging financial markets would have any real effects on the economic determinants of claims across countries. The evolution of ownership has been impressive. As shown in Figure 4, by 1999, bank assets under foreign control were dramatically higher than five years before. By 2003, there were more nuanced developments. Still, procyclical lending occurs.

Why should there be a relationship between this type of financial intermediation and shock transmission? Theoretical arguments show us why banks may magnify or dampen local business cycles and transmit foreign shocks through the lending channel. The reasons offered for cyclicality in lending include: market risk changing cyclically, so that asset demands and supplies change (as in Berlin and Mester 1999); mismeasurement of difficulties in downturns and strengths in boom periods (as in Borio, Furfine, and Lowe 2001); and the type of intertemporal smoothing, leading to countercyclical loan demand, as in the literature behind the quantity puzzle discussions.

Figure 4
Bank assets under foreign control, 1994, 1999, and 2003
(Assets of banks in which foreigners own 40 per cent or more of bank)



Source: Mathieson and Roldos (2001), plus calculations using Fitch IBCA Bankscope.

Both foreign banks (multinationals) and domestic banks are procyclical suppliers of credit. Both contribute to international business cycle integration but not necessarily to smoothing. Domestic banks rely more on domestically generated sources of funds for lending activity, so their lending is highly procyclical. It is sensitive to domestic cycles and increases the amplitude of these cycles. Foreign banks rely more on source-country funds. They transmit slightly more of their own country shocks to markets in which they have a presence, but also reduce the amplitude of locally generated cycles.

Instead of leading to real consumption smoothing through lending channels, how else can real financial integration promote smoothing of local shocks? Some ideas to explore are: (i) through the development of local institutions; (ii) through bank integration with foreign head offices, which can lead to stronger risk-management systems/operational controls; and (iii) through product innovation and expansion of services (broader range of credit and deposit products, treasury, financial advisory services, etc.). There is also anecdotal evidence of spillovers to supervision.

Is there more of a story to tell for these alternative channels of effects in an intranational versus international setting? This point warrants exploration. The Jean Imbs paper takes us in the right direction and can usefully explore these themes further.

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General Discussion*

Andrew Rose responded to Eric Santor's comments by noting that it was unlikely that exchange rate movements were the driving factor, as the analysis of daily and monthly data delivers similar results. Rose acknowledged that firms listed on the TSE may have different features, such as different ownership structure, but emphasized that it doesn't change the fact that the expected marginal rates of substitution are not equal across markets. With respect to adequacy of the instruments used, Rose reported that the first-stage regressions explained about 80 per cent of the variance. He also responded that they had simply sorted the portfolios alphabetically. He welcomed further research by others on sorting strategies.

Jean Imbs responded to Linda Goldberg's comments by noting that the paper's findings were consistent with procyclical lending patterns that Goldberg had indicated. He agreed that it would be interesting to look at interregional and international sources of funding.

In the general discussion that followed, Charles Engel pointed out that Andrew Rose's analysis assumes a representative investor rather than heterogeneous agents. Moreover, as purchasing-power parity (PPP) does not hold, prices will differ between the United States and Canada. Thus, the expected marginal rate of substitution will differ between countries even under perfect financial integration so long as markets are incomplete. Essentially what Rose estimates is a weighted average of marginal rates of substitution. Rose underscored that what was actually being estimated was the expected, not the actual, marginal rate of substitution. While

* Prepared by Robert Lafrance.

heterogeneity among investors is plausible, Rose doubted that this could account for the large differences in the expected marginal rate of substitution between markets as estimated in the paper.

In a follow-up comment on Imbs's paper, Engel pointed out that perfect financial markets do not imply perfect risk sharing as long as PPP doesn't hold. This raises the question of what we are trying to measure. If the real exchange rate is not a constant, then perfect risk sharing is not an optimal strategy. He asked whether the framework used in the paper could be extended to deal with that issue. Imbs replied that there are many reasons why risk sharing may not be occurring in the data. In practice, the ratio of marginal utilities is not equal to the real exchange rate. Including real exchange rates in the estimation was not likely to change his results. Gregor Smith sought to clarify the identification assumption in equation 8 in Rose's paper, since it seemed different from the conventional approach. Rose agreed. In effect, he had used an econometric trick to avoid explicit identification of factors. Lawrence Schembri asked how the difference in expected marginal rate of substitution between Canadian and US financial markets compared with other markets and how it might have changed over time. Rose replied that the only other comparison he had done was between the NYSE and NASDAQ, which showed, surprisingly, a similar result.

In reference to Imbs's paper, Graham Voss questioned pooling US and Canadian data, given that these two countries have very different banking systems. He suggested that one could look at the two countries separately. Imbs explained that pooling was required, since Canada had too few jurisdictions.

Session 2:
Exchange Rate Determination in a Global Setting

Multilateral Adjustment and the Canadian Dollar

*Jeannine Bailliu, Ali Dib, and Lawrence Schembri**

Introduction

In 2003, the Canadian dollar appreciated by almost 25 per cent in less than twelve months; it was the most rapid rise of the dollar on record. Since the exchange rate directly influences the link between external demand and domestic economic activity, this appreciation posed a serious challenge for monetary policy. In particular, the appropriate monetary policy response depended on the factors underlying this movement. In theory, the monetary policy response to a sustained exchange rate appreciation or depreciation would be muted if this relative price movement were driven largely by real fundamentals, normally identified as shifts in the demand for and supply of Canadian-produced goods and services relative to those produced in the rest of the world.[1] Some monetary accommodation, however, might be useful in this case, because it would facilitate the reallocation of resources between traded and non-traded sectors in response to the exchange rate movement.

Attempting to understand the forces behind the rapid appreciation of the dollar in 2003 is the primary motivation for this paper. It is well known that adequately explaining the behaviour of exchange rates is one of the major

1. If, however, an exchange rate movement were driven by non-fundamental (e.g., speculative) forces, then monetary policy should react to neutralize the effect of these forces in order to shelter the domestic economy from unnecessary movements in the exchange rate.

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puzzles in international economics. For the Can$/US$ bilateral exchange rate, the Bank of Canada has developed an equation based primarily on non-energy commodity prices and lagged interest rate differentials that seems to explain movements in the exchange rate reasonably well.[2] There are episodes, however, such as in 2003, when the equation fares poorly in explaining the rapid appreciation, because there are other factors driving the exchange rate that are not included in the empirical model.

This paper focuses on one potential explanation: namely, that the bilateral exchange rate equation currently in use at the Bank of Canada does not fully allow for multilateral adjustment to US current account and fiscal imbalances. In particular, because the US economy occupies a predominant position in the world economy, when it incurs, for example, a current account deficit that is viewed as unsustainable, then all countries will see the value of their currencies appreciate relative to the US dollar to facilitate global adjustment to the US imbalances. A multilateral adjustment, however, cannot easily be captured by an equation that uses only bilateral differences in macro variables as explanatory variables, because the bilateral current account position is of little relevance in explaining a current account imbalance that is determined by transactions with all other countries. In 2003, the United States was running a current account deficit of roughly 5 per cent of gross domestic product (GDP) that many observers felt was unsustainable at the existing exchange rate levels. Consequently, all major currencies began to appreciate relative to the US dollar. Table 1 shows that the rapid appreciation of the Canadian dollar was comparable to that experienced by other currencies.

To capture situations in which the Canadian dollar is being driven largely by the forces of multilateral adjustment to US imbalances, we need to go beyond the standard bilateral empirical exchange rate model, such as the one developed by the Bank of Canada. Bilateral models are common in the literature, despite the fact that they ignore multilateral influences, because they are relatively easy to estimate and interpret, and in most periods, but not all, provide relatively good explanations of the observed movements in exchange rates. To capture fully, however, the multilateral influences would require an econometric dynamic general-equilibrium (DGE) model, which is much more difficult to estimate and interpret. Moreover, the cost of

2. The original research on the exchange rate equation was done by Amano and van Norden (1993). Their key finding was that separating Canada's terms of trade into energy and non-energy components greatly increased the equation's explanatory power. Subsequent research by Murray, Zelmer, and Antia (2000) extended the model. Ongoing research by Helliwell et al. (2005) focuses on the role of relative productivity as a determinant of exchange rate movements.

Table 1
Nominal appreciation from 2 January 2003 vs. US$ (percentage)

	To 1 October 2003	To 9 January 2004 (CAD Peak)	To 27 September 2004
Canadian dollar (Can$)	16.82	24.07	23.63
Euro	12.96	24.01	18.76
British pound	4.30	15.62	13.14
Japanese yen	8.34	12.53	7.84
Australian dollar	21.31	38.07	26.66
New Zealand dollar	14.42	30.46	27.44

Source: Daily recorded values at 12:00 p.m. EST by the Bank of Canada.

operationalizing such a model may not be worth the potential benefit in terms of additional explanatory power. Thus, our approach in this paper is to extend the bilateral model by adopting a threshold methodology that will allow the specification of the empirical model to change when US macroeconomic imbalances are significant. The rationale for such an approach is that, under normal circumstances, the forces of multilateral adjustment are superseded by bilateral considerations, and only when US imbalances are large does the need for multilateral adjustment dominate.

The key finding in this paper is that in periods when the United States is running a substantial fiscal deficit (i.e., more than 2 per cent of GDP), the specification of the empirical regression model describing the Canadian dollar changes. The result is intuitively appealing, because during episodes in the post-Bretton Woods period when the US fiscal deficit was large, especially on a cyclically adjusted basis, the United States often had a substantial current account deficit. Yet the reverse was, in general, less often true, because current account deficits also occurred during investment booms when there was a fiscal surplus. Hence, US current account deficits generated by increases in government spending or tax cuts appear to have been viewed by the market as less sustainable (perhaps because the foreign borrowing was not used to finance investments that would have generated sufficient returns to service the debt) and thus warranted a substantial multilateral exchange rate adjustment.

The paper is organized into six sections. The next section examines large US external imbalances since the Bretton Woods period and their implications for the adjustment of exchange rates, including the Canadian dollar. Section 2 provides theoretical arguments for a multilateral approach to exchange rate modelling, in general, and the threshold approach, in particular. The empirical framework and data required are explained in section 3, which is followed in section 4 by a description of the estimation

procedure and a presentation and interpretation of the empirical results. Concluding remarks are made in the final section.

1 US Imbalances in the Postwar Period and the Canadian Dollar

Since 1960, the United States has experienced two periods of significant external imbalance. Figure A1.1 in Appendix 1 shows that the first imbalance took place over the period 1984 to 1989, when the US current account deficit exceeded 2 per cent of GDP over the entire six-year period, which, at that time, was the largest US deficit recorded in the postwar period. More recently, the US current account went into deficit starting in 1992, but only crossed the 2 per cent of GDP threshold in 1998, and it has continued to increase, with the deficit now approaching 6 per cent of GDP in 2004.

Figure A1.1 displays the US current account and the Can$/US$ exchange rate.[3] The figure shows that the exchange rate and the US current account are most closely correlated during the two periods of significant US external imbalance. In particular, the value of the Canadian dollar and the US current account hit bottom at roughly the same time. This was clearly true in the 1980s, whereas in the most recent period, the US current account has continued to decline, despite the depreciation of the US dollar. In addition, in the earlier period as the Canadian dollar subsequently appreciated relative to the US dollar, the US current account deficit shrank. This pattern is expected to be repeated in the most recent period as well, but it is not clear when the US current account will turn around. The experience of the Canadian dollar is not unique, however, as the movements of currencies of other countries during these two periods are somewhat similar. Figure A1.2 shows the US dollar effective nominal rate (expressed as the US-dollar price of a trade-weighted basket of currencies) and the US current account. Again, the correlation between the effective rate and the current account appears strongest when the US external imbalances are significant, although the correlation is not as strong as with the Canadian dollar exchange rate. In particular, during the 1980s, the effective US nominal rate begins to depreciate slightly before the trough in the US current account. In the most recent period of external imbalance, the path of the effective nominal rate is essentially the same as that of the Canadian dollar.

3. Given that real and nominal exchange rates are highly correlated, Figures A1.1 and A1.2 show only the nominal exchange rates.

Hence, the evidence seems to suggest that when US external imbalances are large, multilateral exchange rate adjustment to these imbalances is driving the movement of bilateral exchange rates. Given that the United States represents approximately 30 per cent of world GDP, it is not unexpected that when it runs a large external deficit, the relative value of the currencies of all other countries (whose currencies float) must change to facilitate the adjustment of the world economy to this imbalance. Indeed, if we compare the simulated values of the nominal exchange rate generated by the Bank of Canada's bilateral exchange rate model (which is discussed in more detail later in the paper) to the actual value of the exchange rate shown in Figure A1.3, we see that the model cannot explain adequately the slope and magnitude of the appreciation of the Canadian dollar in 2003.

To examine these US external imbalances further, it is useful to employ the national income accounting identity; this identity implies that current account imbalances occur when there are fiscal deficits or a deficit of private savings relative to domestic investment.[4] Figure A1.4 plots the US current account deficit and the US federal government fiscal deficit. Also shown is the difference between private savings and investment, which is calculated as the residual. Figure A1.4 shows that over the periods 1984–88, and 2002–04, the large US external balances coincided with large fiscal deficits. When this simultaneous occurrence was observed in the 1980s, it was labelled the "twin-deficits" phenomenon, and the argument was made that the significant reductions in taxes and the concomitant increase in military spending during the Reagan administration caused both the fiscal and current accounts deficits over this period.[5] While there was much public debate over this causal argument at the time, the standard non-Ricardian, open-economy model would predict that a temporary increase in domestic (government) spending would increase the current account deficit. This increase in demand would fall partly on traded goods, but largely on non-traded goods and services. Thus, resources would be shifted out of the traded goods sector to meet this demand. As a result, there would be less domestic supply of traded goods to satisfy the increase in demand, and a current account deficit would ensue. Domestic interest rates would rise and foreign borrowing would be used to finance the higher level of absorption.

The second period of significant external imbalance (i.e., more than 2 per cent of GDP), 1998 to 2004, is different from the earlier period in the 1980s, because the imbalance occurred several years before the fiscal deficits of

4. Because the relation is an identity and because most of the variables are endogenous, care must be taken when using the identity to make causal statements.

5. Mann (1999, 2002) provides an insightful discussion of the twin-deficits experience in the United States.

2002–04; indeed, the US current account deficit begins when there is a large fiscal surplus. The critical difference is that over this period (1998–2001), the current account deficit is caused by an investment boom and relatively low domestic savings. As a result of this investment-savings gap, foreign capital flowed into the United States in expectation of higher returns owing to the rapid increases in productivity, which were anticipated to continue for the foreseeable future. This expectation of higher productivity growth also increased domestic consumption and reduced savings as US residents intertemporally shifted higher expected future outputs and incomes to the present.

It is also noteworthy that in the three recessionary periods, 1974–75, 1981–82, and 1991–92, there was slowdown in economic activity, and consequently, the fiscal position went into deficit because of lower tax revenues and increased transfers, and the current account deficit declined as imports fell. In these situations, higher fiscal deficits did not coincide with current account deficits, because aggregate investment fell below savings as economic prospects turned negative. To measure the underlying degree of fiscal stimulus, it is sometimes useful to adjust the fiscal position for effects of the business cycle. In Figure A1.5, the cyclically adjusted fiscal position is included in addition to the fiscal and current account positions. This figure shows clearly that a large part of the fiscal deficits observed during these episodes were indeed cyclical.

In summary, we have tried to demonstrate in this section that two large appreciations of the Canadian dollar, and also that of other currencies, have taken place as a result of multilateral adjustments to large US external imbalances, which were caused in part by fiscal imbalances. Thus, incorporating this multilateral adjustment into an empirical model of the Canadian exchange rate may help improve the explanatory power of the traditional bilateral model.

2 Theoretical Considerations

The discussion in the previous section suggests that there are periods in which movements in the Canadian dollar that are not well explained by intercountry differences in Canada-US fundamentals may be accounted for by factors driving the US dollar. Therefore, an analysis of the Canadian dollar based on a bilateral exchange rate equation that does not account for these multilateral effects stemming from the United States may suffer from omitted variable bias. Furthermore, it also suggests that these effects can be modelled as threshold effects given that they likely only emerge as an important determinant of the Canadian dollar in periods where there are significant imbalances. The determinants of a currency like the Canadian

dollar might thus be better modelled in the context of a model with two regimes: one in which intercountry differences in Canada-US fundamentals are the main drivers of the bilateral exchange rate and a second in which multilateral effects from the United States kick in to become an additional important determinant.

Although little research has been conducted on modelling multilateral exchange rate effects, a number of multi-country empirical models have been developed that account for these types of factors. In addition, the concept has been discussed in the econometric literature, and empirical evidence suggests the presence of such effects. Furthermore, the inclusion of a multilateral term in a bilateral exchange rate equation—as well as its treatment as a threshold effect—can be motivated theoretically by drawing on related work. This section first discusses the theoretical rationale for multilateral currency effects, then provides an overview of how these effects have been modelled in multi-country empirical models, and concludes by reviewing the empirical evidence.

2.1 Theoretical rationale for multilateral currency effects

The bulk of the empirical literature that examines the macroeconomic determinants of exchange rates is based on a two-country framework where the bilateral exchange rate is viewed as the relative price of the monies of the two countries in question.[6] There are a large number of such models, all of which describe the evolution of the exchange rate as being a function of a different set of fundamentals. Cheung, Chinn, and Pascual (2002) provide a useful overview of the main empirical models used in the 1990s in their update of Meese and Rogoff's (1983) work comparing the forecasting performance of the major models used in the 1970s. As they discuss, these models view the bilateral exchange rate as a function of variables such as prices, money, income, interest rates, productivity differentials, relative price of non-tradables, government debt, terms of trade, and net foreign assets—typically expressed as *intercountry* differences.

In contrast, empirical exchange rate models that incorporate multilateral effects view exchange rates as being interdependent. In this type of framework, a bilateral exchange rate can thus be driven either by intercountry differences in its fundamentals, as noted above, or by fundamentals that are influencing another currency (i.e., multilateral effects). There are a few potential explanations for this latter phenomenon.

6. This type of framework also typically underlies empirical work focusing on the determinants of effective exchange rates where the second country in this case is defined as the rest of the world (expressed in a trade-weighted fashion).

First, news about the fundamentals of the other currency may reveal information about the domestic economy. For instance, news about US fundamentals may reveal information about the Canadian economy. And given the economic significance of the United States, news about US fundamentals may provide information regarding the direction of the world economy, both of which should influence the Canadian dollar.[7] Second, multilateral effects could arise because of trade and financial market linkages across countries. In other words, given that the real and financial sectors of the world economies are linked, so will their respective exchange rates be linked. This is the basic idea behind models of exchange rate determination based on a multi-country framework, which are discussed below.

Finally, the treatment of multilateral factors as threshold effects can be motivated by drawing on an exchange rate model based on informational heterogeneity. Developed by Bacchetta and van Wincoop (2004), this framework was inspired by survey data that suggest that foreign exchange traders change the weight they attach to different macroeconomic indicators over time. Based on this, they develop a "scapegoat" model where foreign exchange traders give a certain fundamental excessive weight during a period of time. The basic mechanism they rely on in the model is confusion in the market as to the true source of exchange rate fluctuations because agents have heterogeneous information. As the market rationally searches for an explanation, it may attribute these fluctuations to some observed macroeconomic indicator; this indicator then becomes the scapegoat and influences trading strategies. This type of model could justify why a variable like the US fiscal deficit might only drive the US dollar once it hits a certain threshold level and becomes a scapegoat variable.

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7. The presence of both chartists and fundamentalists in the foreign exchange market may also explain the occurrence of multilateral effects (Frankel and Froot (1988) were the first to develop a foreign exchange rate model with these two types of agents). For example, suppose that chartists apply a trading rule where they buy or sell US dollars relative to all currencies in response to a movement in the US dollar. This movement in the effective US dollar could have occurred as a result of fundamentalists buying or selling the US dollar in response to a change in a US fundamental. The fundamentalists, however, would only trade in a bilateral currency if the change in the US fundamental had a caused a change in the fundamental *relative* to the other country, whereas the chartists would simply apply the trading rule regardless of intercountry differences in fundamentals. Thus, a change in a US fundamental that did not result in a variation in the intercountry difference in that fundamental with respect to Canada could still influence the Canadian dollar.

2.2 Modelling multilateral exchange rate effects

In contrast to the traditional two-country framework that is typically used in the empirical exchange rate literature, models that incorporate multilateral exchange rate effects view exchange rates as being based on a multi-country framework. For example, the Research Department at the International Monetary Fund (IMF) has developed a multi-country approach to estimating equilibrium exchange rates. This work, outlined in Isard and Faruqee (1998) and Faruqee, Isard, and Masson (1999), is based on the macroeconomic balance framework, which defines the equilibrium exchange rate as the level of the real exchange rate that achieves both internal and external balance simultaneously (it is assumed that this occurs in the medium term). In these studies, the equilibrium real exchange rate is defined as the level of the real exchange rate that would equate the cyclically adjusted current account balance, as estimated from a standard trade model, to the equilibrium current account position.[8] This concept of the equilibrium exchange rate is viewed in the medium-term context when all output gaps are assumed to go to zero (and hence economies are in a position of internal, as well as external, balance). Both the cyclically adjusted and equilibrium measures of the current account for each country are estimated in a multi-country setting to capture the interdependent nature of these variables, and hence also of the equilibrium exchange rates (i.e., given that the latter are consistent with the attainment of internal and external balance in all countries in the *world*). Thus, an exchange rate will only be in equilibrium in this model provided that all the other exchange rates in the system are also in equilibrium.

In some earlier work, Buttler and Schips (1987) also compute equilibrium exchange rates based on a multi-country version of the macroeconomic balance approach. In contrast to the IMF studies, they limit the number of currencies in their model to six major currencies plus a composite currency for the rest of the world.[9] In addition, they define equilibrium exchange rates as those that are consistent with a world equilibrium that is achieved when the following conditions hold for all countries in the system: (i) current accounts are in balance, (ii) real incomes are adjusted for changes in the current account, and (iii) other domestic variables remain constant.

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8. The equilibrium current account is estimated using two different methodologies. In the first, the equilibrium current account is defined as the level that stabilizes the net foreign assets to GDP ratio at an appropriate level. The second is based on an estimated model that links saving and investment flows to their structural determinants and views the equilibrium current account position as determined by the cyclically adjusted saving-investment balance, conditional on policies and other exogenous variables.

9. The six major currencies they consider are the US dollar, Japanese yen, German mark, Canadian dollar, pound sterling, and Swiss franc.

The role of multilateral effects has also been examined in the context of target-zone models. Flandreau (1998) extended Krugman's model of a bilateral target zone to a multilateral context where exchange rates depend on all the fundamentals in the system (i.e., each country's fundamentals affect all the exchange rates in the system). In this type of framework, interventions aimed at influencing one given exchange rate turn out to influence other exchange rates as well.

Another approach used in the literature that recognizes the interdependent nature of equilibrium exchange rates is to estimate globally consistent bilateral exchange rates based on a two-country model. Alberola et al. (1999) use such an approach. They estimate bilateral equilibrium exchange rates for several currencies, using a methodology that ensures global consistency between the multilateral and bilateral exchange rates in the system. Based on a simple two-country theoretical framework, they develop an empirical model that describes the evolution of the real exchange rate as a function of two key fundamentals: a relative sectoral price differential index and the level of net foreign assets.[10] After showing the existence of a cointegration relationship between the real exchange rate and these fundamentals in the panel of currencies under study, the authors decompose the real exchange rate into permanent and transitory components; the time-varying permanent component is identified as the equilibrium exchange rate. A series of globally consistent bilateral equilibrium exchange rates is then derived based on the estimates for the effective rates.

2.3 Empirical evidence

Although relatively little empirical research has been conducted on multilateral exchange rate effects, there is evidence suggesting the presence of such effects.[11] For instance, MacDonald and Marsh (2004) extend a

10. In their study, the equilibrium exchange rate is defined as the level of the real exchange rate that is associated with both internal and external balance in the economy. The former occurs when there is no excess demand in the non-tradable sector, whereas the latter is characterized by the achievement of a desired stock of net foreign assets.

11. Another strand of the literature has examined the related question of whether there are volatility spillovers in exchange rates both across markets and across currencies. In seminal papers in this area, Engle, Ito, and Lin (1990) and Ito, Engle, and Lin (1992) found evidence of so-called *meteor-shower effects*, or volatility spillovers across regional markets for the same currency (i.e., the US dollar-Japanese yen exchange rate). Melvin and Melvin (2003) confirmed this result using a richer data set. There is also evidence confirming the presence of cross-currency effects. Indeed, using multivariate stochastic volatility models, Chowdhury and Sarno (2004) found that cross-country volatility spillovers play a role in explaining currency volatility, albeit not as important as that played by lagged own-volatility (so-called *heat-wave effects*).

single-currency exchange rate model based on the joint modelling of exchange rates, prices, and interest rates to a multi-currency setting to capture spillover effects among the three major currencies (i.e., the US dollar, the Japanese yen, and the German mark). They build on a single-currency model developed in previous work (see, for example, MacDonald and Marsh 1997), which is predicated on the Casselian view of purchasing-power parity (PPP). The latter assumes that absolute PPP holds only in the very long run, and hence that there could be deviations in the short, medium, or even long run owing to factors such as capital flows. To capture this, they supplement PPP with an uncovered-interest-rate-parity (UIRP) condition and model the relationship using a vector error-correction model (VECM) with exchange rates, prices, and interest rates.[12] In the multi-currency setting, MacDonald and Marsh model spillovers both in the long-run relationship and in the short-run dynamics. Thus, the error-correction term in each bilateral exchange rate equation will capture the response of the exchange rate to its long-run fundamentals, which include the other bilateral exchange rate in the tri-polar system, as well as prices and interest rates for the three countries. The latter are also used to capture short-run dynamics. The authors find that their tri-polar model generally out-performs the random walk in out-of-sample forecasting exercises.

Hodrick and Vassalou (2002) also find evidence that an exchange rate specification based on a multi-country framework can outperform a specification based on a two-country model. Using a multi-country model of the term structure, they find evidence that the first moment of the German mark-US dollar exchange rate is influenced by third-country factors. However, they find no evidence of spillover effects for the other bilateral exchange rates considered (i.e., those for Japan and the United Kingdom) nor any evidence of spillovers in the second moments of the exchange rates considered. Their results thus suggest that, in some cases, multi-country models that incorporate spillover effects from third countries contain more information than traditional two-country models.

3 Empirical Framework

3.1 A model of the bilateral exchange rate with multilateral effects

As a starting point for our analysis, we use an error-correction model for the bilateral Canada-US real exchange rate that was initially developed by

12. It is worth pointing out that exchange rates, prices (domestic and foreign), and interest rates (domestic and foreign) are used to capture both long-run equilibria and short-run dynamics in their VECM.

Amano and van Norden (1993). This single-equation model is built around a long-run relationship between the real exchange rate, real energy commodity prices, and real non-energy commodity prices.[13] Short-run dynamics are captured by an interest rate differential and a relative public sector indebtedness term. Although parsimonious, this equation has been relatively successful at tracking most of the major movements in the Canadian dollar over the past few decades, has proven to be stable over time, and has outperformed the random walk in out-of-sample forecasting exercises.[14]

The specification for the single-equation model is as follows:

$$\Delta \ln(rfx) = \alpha(\ln(rfx_{t-1}) - \beta - \phi \ln(comtot_{t-1}) - \pi \ln(enetot_{t-1})) + \delta intdif_{t-1} + \gamma \Delta debtdif_{t-1} + \varepsilon_t, \quad (1)$$

where rfx is the real Canada-US dollar exchange rate;[15] $comtot$ is the real non-energy price index;[16] $enetot$ is the real energy price index; $intdif$ is the Canada-US short-term interest rate differential; and $\Delta debtdif$ is the first difference of the Canada-US relative public sector debt. Appendix 2 provides more details on the data. Unit-root tests were conducted on all the series in equation (1) using the Dickey-Fuller Generalized Least Squares (DF-GLS) test developed by Elliott, Rothenberg, and Stock (1996). The results, as well as a description of this test, are provided in Table A3.1 in Appendix 3. The results suggest that rfx, $comtot$, and $enetot$ are non-stationary and that $intdif$ is stationary, as assumed. However, the results also suggest that $\Delta debtdif$ is non-stationary, which is contrary to what is assumed (and to what unit-root tests in the past have found). Thus, this variable cannot be left in the equation as is, given that it is an I(1) variable and its inclusion to capture short-run dynamics would result in an unbalanced equation.

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13. Under certain circumstances, a single-equation approach—as opposed to estimating the entire vector error-correction model—can be justified. Indeed, as discussed by Johansen (1992), estimation and inference based on the single-equation system will be equivalent to that of the full system if there is only one cointegrating vector and all the other cointegrating variables are weakly exogenous with respect to the first variable under consideration (in this case, the real exchange rate). As shown in Tables A3.2 and A3.4 in Appendix 3, cointegration and weak exogeneity tests support this approach.

14. For more information on this equation and its performance over time, see Murray, Zelmer, and Antia (2000).

15. The nominal exchange rate is deflated by the ratio of the GDP deflators for the two countries.

16. The energy and non-energy price indexes are each deflated by the US GDP deflator to convert them into real terms.

As shown in Appendix 3, there is a cointegrating relationship between the real exchange rate, the real non-energy commodity prices, and the real energy prices—*rfx*, *comtot*, and *enetot*. This is shown in Table A3.2, which reports the Johansen cointegration test statistics (i.e., the trace and Lambda-max statistics) as well as the 5 per cent critical value for these tests, as computed in MacKinnon, Haug, and Michelis (1999). In all cases, the null hypothesis is rejected if the test statistic is larger than the critical value. These results thus support the presence of one cointegrating vector between the real exchange rate, real non-energy commodity prices, and real energy commodity prices. We also tested for the presence of a cointegrating relationship between these three variables and the level of the Canada-US relative public sector debt (which, as shown in Table A3.1, is a non-stationary variable). It does seem more intuitive that this variable should influence the long-run value of the real exchange rate rather than the short-run dynamics. However, previous work had failed to find a long-run cointegrating relationship between these four variables.[17] As shown in Table A3.3, the Johansen cointegration test statistics also support the presence of one cointegrating relationship between the real exchange rate, real non-energy commodity prices, real energy commodity prices, and the level of the Canada-US relative public sector debt.

We make two modifications to this basic framework. First, we remove the $\Delta debtdif$ term from the short-run dynamics and consider two versions of the model: one with the three variables depicted in equation (1) in the cointegrating relationship and another with these three variables plus the level of the Canada-US relative public sector debt in the cointegrating relationship. Second, we add two terms to reflect multilateral exchange rate effects stemming from the United States. As discussed in section 2, the two key variables that reflect US imbalances and that are likely to instigate a multilateral adjustment of the US dollar are the US fiscal deficit and the US current account deficit.

Unit-root tests were also conducted on these two variables and are reported in Table A3.1. As shown, the DF-GLS unit-root test suggests that the fiscal balance to GDP ratio follows a stationary process but that the current account to GDP ratio contains a unit root. The latter is contrary to what one would expect and suggests that the intertemporal budget constraint is violated and that the current account is on an explosive path. Christopoulos and León-Ledesma (2004) also find that traditional unit-root tests for the US current account to GDP ratio suggest that the series is non-stationary, even when the sample is extended back to 1960. However, they argue that these tests suffer from an important loss of power if the dynamics of the series

17. See, for instance, Djoudad and Tessier (2000).

being tested exhibit non-linearities, which they show is the case for the US current account. They address this issue by analyzing the stationarity of the US current account using new econometric tests based on a non-linear adjustment, and find evidence that the US current account to GDP ratio is stationary when this non-linearity is taken into account. Given these results and our priors based on theoretical considerations, we decide to treat the US current account to GDP ratio as a stationary variable in our analysis.

By making these modifications, we obtain the following specifications for the two versions of our model:

$$\Delta \ln(rfx) = \alpha(\ln(rfx_{t-1}) - \beta - \phi \ln(comtot_{t-1}) - \pi \ln(enetot_{t-1})) + \delta intdif_{t-1} + \chi US\_cabal_{t-1} + \lambda US\_fisbal_{t-1} + \varepsilon_t \quad (2a)$$

$$\Delta \ln(rfx) = \alpha(\ln(rfx_{t-1}) - \beta - \phi \ln(comtot_{t-1}) - \pi \ln(enetot_{t-1}) - \eta debtdif_{t-1}) + \delta intdif_{t-1} + \chi US\_cabal_{t-1} + \lambda US\_fisbal_{t-1} + \varepsilon_t, \quad (2b)$$

where the dependent variable and the first four explanatory variables in equation (2b) were explained above; *US_cabal* is the US current account balance as a proportion of GDP; and *US_fisbal* is the US fiscal balance as a proportion of GDP. Equations (2a) and (2b) depict two versions of our bilateral exchange rate equation that incorporate multilateral factors but do not treat them as threshold effects. The next section describes a threshold model of the bilateral exchange rate with multilateral effects.

Before turning to the threshold model, it may be useful to discuss the expected signs on the coefficients in equations (2a) and (2b). First, the energy and non-energy price indexes in the cointegrating vector are proxies for the Canadian terms of trade and should play a role in the determination of the long-run value of the Canada-US dollar exchange rate. Since Canada is a major net exporter of both energy and non-energy commodities, one would expect that an increase in their price would lead to an appreciation of the Canadian dollar.[18] Second, the level of government debt in Canada relative to that in the United States should also play a role in the determination of the Canadian dollar in the longer run. One would expect an increase in this ratio to lead to a depreciation of the Canadian dollar in the

18. In terms of energy commodities, Canada became a major net exporter starting in the early 1990s with the increase in natural gas exports to the United States. Before then, net exports of these commodities were much smaller and sometimes negative.

long run, since higher Canadian government debt will likely lead to both higher domestic and foreign debt, which will eventually necessitate higher net exports to finance this excess absorption. It should be noted that in the short run, the effects on the exchange rate can be ambiguous. Indeed, the stimulative effects of higher government debt could put upward pressure on the currency in the short run, but this could be partially or fully offset by risk considerations if the level of the debt increased beyond the level considered to be sustainable.

Third, the Canada-US short-term interest rate differential term captures the effect of relatively higher interest rates in Canada—as a result of, for instance, relatively tighter monetary policy in Canada—on the Canada-US exchange rate. One would expect that an increase in this variable would lead to an appreciation of the Canadian dollar, as an increase in the rate of return of Canadian dollar-denominated assets should increase the demand for such assets.

Finally, the expected effects of the US current account and fiscal balances on the Canadian dollar are ambiguous. The arguments for the effects of the fiscal balance on the national currency were presented above, and suggest that they depend on both the time horizon and the market's perception as to the sustainability of the level of national debt. Similar arguments can also be made for the current account balance. Thus, if the US government is running fiscal and current account deficits, this could put upward pressure on the US dollar and hence lead to a depreciation of the Canadian dollar, as long as the market perceived the twin deficits to be sustainable. If, however, the market's perception were to change, this could reverse the effect and lead to downward pressure on the US dollar and hence an appreciation of the Canadian dollar. This analysis suggests that the effects of these US variables on the Canadian dollar might be best modelled in a framework with threshold effects. Such an approach is developed in the next section.

3.2 A threshold model of the bilateral exchange rate with multilateral effects

Threshold regression models have a variety of applications in economics and have increased in popularity in recent years. This type of model splits the sample into "regimes" based on the value of an observed variable, the so-called threshold variable. Given that the threshold level of the variable is typically unknown, it needs to be estimated along with the other parameters of the model. Several authors have contributed to developing a theory of estimation and inference of threshold models (also referred to as sample-splitting models) over the past decade or so, including Chan (1993), Hansen (1996, 1999), Caner (2002), and Caner and Hansen (2004).

Our bilateral exchange rate equation with multilateral effects shown above can be transformed into the following threshold model with two regimes:

$$\Delta\ln(rfx) = \alpha_1(\ln(rfx_{t-1}) - \beta_1 - \phi_1\ln(comtot_{t-1}) - \pi_1\ln(enetot_{t-1}))$$
$$+ \delta_1 intdif_{t-1} + \chi_1 US\_cabal_{t-1}$$
$$+ \lambda_1 US\_fisbal_{t-1} + \varepsilon_t, \qquad q_t \le q^* \tag{3a}$$

$$\Delta\ln(rfx) = \alpha_2(\ln(rfx_{t-1}) - \beta_2 - \phi_2\ln(comtot_{t-1}) - \pi_2\ln(enetot_{t-1}))$$
$$+ \delta_2 intdif_{t-1} + \chi_2 US\_cabal_{t-1}$$
$$+ \lambda_2 US\_fisbal_{t-1} + \varepsilon_t, \qquad q_t > q^*. \tag{3b}$$

where q is the threshold variable and q^* is the estimated threshold value. It is worth pointing out that this model allows the regression parameters to vary in the two regimes. We use the first lag of US fiscal balance as a proportion of GDP as our threshold variable to reflect the likelihood of multilateral exchange rate adjustment to a twin-deficits situation. The estimation procedure is discussed in the next section.

4 Estimation Methodology and Results

4.1 Estimation procedure

The parameters in the two single-equation models (equations (1) and (2)) are estimated by the non-linear least-squares method. Such a procedure is necessary given the presence of the long-term relationship between the real exchange rate, the terms-of-trade variables, and the debt differential (i.e., the error-correction terms). On the other hand, the threshold regression model (equation (3)) is estimated using a two-step procedure. The first step involves estimating the threshold parameter, q^*, that splits the sample into two regimes. In the second step, the other parameters associated with each regime are then estimated.

Simplifying Hansen's (1999) notation, we rewrite the threshold regression model (equation 3) in the following form:

$$y_t = \theta_1' X_t + e_t, \qquad q_t \le q^* \tag{4}$$

$$y_t = \theta_2' X_t + e_t, \qquad q_t > q^*, \tag{5}$$

where θ_1 and θ_2 are two parameter vectors associated with regimes 1 and 2, the observed sample is $\{y_t, X_t, q_t\}_{t=1}^{T}$, y_t is the dependent variable

$(\Delta \ln(rfx_t))$, X_t is a vector of exogenous variables, q_t is the threshold variable that is also included in X_t, and e_t is a mean-zero disturbance term.[19] The threshold parameter q^*, which is an element of q_t, is unknown and needs to be estimated.

The estimator of q^* minimizes the sum of squared errors from the regression of y_t on X_{qt} where $X_{qt} = X_t$ (if $q_t \leq q^*$) or 0 otherwise. The non-linear least-square estimator of q^* minimizes the sum of squared errors, $S_t(q^*)$, as follows:

$$q^* \text{ minimizes } S_t(q^*);\ q^* \text{ is an element of } q_t. \tag{6}$$

Since $S_T(q^*)$ may take T distinct values, the estimation of q^* requires T evaluations of the function $S_T(q^*)$ (where T is the total number of observations).

As mentioned earlier, we use the first lag of the US fiscal balance, US_fisbal_{t-1}, as the threshold variable, q_t. The estimated value of the threshold parameter, q^*, is –2.65. Given the estimate of the threshold q^*, the sample is split into two subsamples, based on the indicators $US\_fisbal_{t-1} > -2.65$ and $US\_fisbal_{t-1} \leq -2.65$. There are 71 observations in the first regime and 52 in the second. Figure A4.1 in Appendix 4 plots the evolution of the two multilateral variables—the US current and fiscal account balances—across the two regimes, where the shaded area indicates periods where the US fiscal balance is below its threshold value of –2.65 per cent of GDP. The two vectors of parameters, θ_1 and θ_2, in equations (4) and (5), are estimated using the non-linear least-squares method separately on each subsample.

4.2 Estimation results

Estimation results for equations (1), (2), and (3) are shown in Tables A4.1 and A4.2 in Appendix 4. Table A4.1 depicts the estimates for the bilateral exchange rate model without the debt differential in the cointegrating relationship (version A of the model), whereas Table A4.2 shows the estimates for the model with the debt differential in the cointegrating relationship (version B of the model). The estimates for the model without multilateral effects are presented first, followed by those for the models with multilateral effects (both with and without threshold effects). The first two models are estimated for the entire sample period (i.e., 1973Q1 to 2004Q1),

19. For example, $\theta_i = (\alpha_i, \beta_i, \varphi_i, \pi_i, \delta_i, \chi_i, \lambda_i)$ for $i = 1, 2$ and $X_t = (1 \ln(rfx_{t-1}) \ln(comtot_{t-1}) \ln(enetot_{t-1}) intdif_{t-1} US\_cabal_{t-6} US\_fisbal_{t-1})$.

whereas the threshold model is estimated for the two subsamples defined by the regimes.

The parameter estimates for the two specifications with multilateral effects in Table A4.1 are generally statistically significant at conventional levels and are of the expected sign. The estimated long-run effects suggest that an increase in the non-energy commodity price index leads to an appreciation of the real exchange rate across both models, as expected. The coefficient on the energy commodity price term is only statistically significant in the first regime of the threshold model, and it is positive, suggesting that an increase in energy prices leads to a depreciation in the Canadian dollar. This seemingly counterintuitive result has been noted in previous research and might be explained by the argument that Canada only became a significant net exporter of energy products starting in the early 1990s and that an energy-price increase could raise the demand for US dollar assets in the short run, especially if the price increase comes at a time of heightened global uncertainty (e.g., the oil-price shocks in 1974 and 1979) and US dollar assets are perceived as a safe refuge.[20] An increase in the Canadian short-run interest rate spread results in an appreciation of the Canadian dollar across all specifications, as expected.

The coefficients on the multilateral variables are also statistically significant, suggesting that multilateral effects do play a role in explaining movements in the Canadian dollar. In the model without threshold effects, both the US fiscal balance and the US current account balance are statistically significant. The coefficients suggest that a deterioration of both the US current and fiscal accounts leads to an appreciation of the Canadian dollar. In the threshold model, the current account balance is statistically significant across both regimes, whereas the fiscal balance is only significant in the first regime (i.e., when the threshold value for the fiscal balance is larger than –2.65 per cent of GDP). It should be noted, however, that the current account variable is lagged six quarters and the fiscal account is lagged three quarters, and thus that effects on the real exchange rate appear nine months to a year and a half later. Given the persistence of both these series, this suggests that the exchange rate responds to cumulative changes in these variables.

The results of the model with the Canada-US debt differential in the cointegrating relationship are shown in Table A4.2. They are very similar to the results for the specification without the debt differential. Although the coefficient on the debt-differential term is statistically significant in the

20. See Krugman (1983) for a model that captures the effect of oil prices on the demand for US-dollar assets.

specification without the multilateral effects, it is only significant in the second regime in the threshold model with multilateral effects. In both cases, it is positive, suggesting than an increase in Canadian government debt relative to the United States will tend to depreciate the Canadian dollar, as expected.

The models with multilateral effects also do a good job of explaining variations in the dependent variable. Indeed, the model without threshold effects explains about 27 per cent of the variation in the real exchange rate (compared to 15 per cent for the model without multilateral effects). The figures are similar for the model with the debt differential. The threshold model does much better, explaining 30 per cent of the variation in the dependent variable in the first regime and 35 per cent in the second regime; the corresponding values for the model with the debt differential are 29 and 47 per cent.

We conducted a series of specification and diagnostic tests on our two models with multilateral effects, equations (2) and (3). First, we tested whether the coefficients on the two multilateral variables, *US_cabal* and *US_fisbal*, are equal to zero. We did this by constructing a likelihood-ratio test using the maximum values of the log-likelihood functions for equations (1) and (2), which are reported in Tables A4.1 and A4.2. The likelihood-ratio test rejects the restriction that the coefficients on the US fiscal and current account balance in equation (2) are equal to zero.[21] Second, we tested whether the model's parameters are equal across the two regimes in equation (3), using a Wald test. Evidence that this was the case would suggest that the model with multilateral effects without threshold effects would be a better specification than that with threshold effects. The Wald test rejected the null hypothesis that all of the estimated parameters of the threshold regression model are stable across the two regimes.[22]

Third, we tested for the presence of serial correlation in the residuals. The Durbin-Watson (DW) tests reported in Tables A4.1 and A4.2 are in the inconclusive region (i.e., between the lower and upper bounds for the test

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21. The likelihood-ratio test statistic is equal to 8.72 (calculated as the difference between the log-likelihood values for the restricted and the unrestricted models times −2) for version A of the model and 10.9 for version B of the model, which are both greater than the 5 per cent critical value of 5.99. This test statistic is distributed as a chi-square with degrees of freedom equal to the number of restrictions (which in this case is two).

22. The Wald statistic is distributed as a chi-square random variable with degrees of freedom under the null hypothesis of parameter stability equal to the number of parameters to be tested. The Wald statistic in this case is 12.97 for version A of the model and 16.37 for version B of the model, whereas the 5 per cent critical value with 7 degrees of freedom is 14.07 and the 10 per cent critical value is 12.02.

statistic), suggesting that no conclusion can be drawn from this test regarding the presence of serial correlation in the residuals. Thus, we also investigated this issue using the Lagrange Multiplier (LM) test, which is valid in a wider range of situations than the DW test and allows for autoregressive or moving-average errors of arbitrary order. The LM test (one and two quarters out) suggested the presence of autocorrelation. To correct for this, we added a lagged dependent variable. By adding this variable to all of our specifications, the problem with serial correlation was eliminated (as shown in the LM test results in Table A4.3) and the estimation results were very similar. We concluded from this exercise that the consequences of the serial correlation were minor and decided to work with our specifications without the lagged dependent variable. Finally, we also tested the residuals for evidence of heteroscedasticity, using the autoregressive conditional heteroscedasticity (ARCH) test of first and second order. As shown in Table A4.3, the ARCH tests suggest that the residuals are not characterized by heteroscedasticity.

4.3 Simulations and forecasting performance

Dynamic simulations of the different models are shown in Figures A4.2 and A4.3 in Appendix 4, using parameter estimates for the entire sample (i.e., 1973Q1 to 2004Q1). Figure A4.2 shows version A of the models (i.e., those without the debt differential in the cointegrating relationship), whereas Figure A4.3 shows version B of the models (i.e., those with the debt differential in the cointegrating relationship). All of the models are fairly successful at accounting for broad movements in the Canada-US real exchange rate over the sample period. As shown, the correspondence between the simulated and actual values is quite close. There are, however, episodes of important deviations between the actual and simulated values—particularly in the mid-1980s, in 1998, and in the early part of this decade—but they tend to disappear after a short period of time. There are also differences across the models. Indeed, the simulated values from the two models with multilateral effects (with and without threshold effects) appear to match more closely the actual values than the Amano-van Norden model. In particular, they are both more successful at accounting for the appreciation of the Canadian dollar in the 2003–04 period, especially the threshold model.

Another way of analyzing these dynamic simulations is to decompose them over two periods: the period from 1973 to 2002 (when there was a broad depreciation of the Canadian dollar) and the period from 2003 to 2004 (when the loonie appreciated). This enables us to examine the relative contribution of the different variables in each model in explaining these two

broad movements in the Canadian currency. Over the period from 1973 to 2002, the Canada-US real exchange rate depreciated by 29 per cent. Table A4.4 shows the decomposition of the dynamic simulations for each model over this period (for version A of the models only). The first column in the table lists the variables included in the different models with an arrow indicating the direction of the movement in the variable in question over the period 1973 to 2002, whereas the second column depicts whether each movement contributed to appreciating or depreciating the currency. As shown, the decline in commodity prices, the increase in energy prices, and the improvement in the US fiscal balance all tended to put downward pressure on the Canadian dollar. On the other hand, this was partially offset by the increase in the Canada-US short-term interest spread and the deterioration of the US current account, both of which tended to appreciate the Canadian dollar.

Given this, the Amano-van Norden model attributed this depreciation mainly to the fall in commodity prices, with a contribution from rising energy prices, and an offsetting effect from an increasing interest rate spread. The other two models found the same qualitative results, but they also suggest that the improvement in the US fiscal balance over this period made a small contribution to the depreciation, and that there was a large offsetting effect on this depreciation from a deterioration in the US current account balance that tended to appreciate the Canadian dollar.

Over the period 2003Q1 to 2004Q1, the Canadian-US real exchange rate appreciated by 14 per cent. Table A4.5 shows the decomposition of the dynamic simulations for each model over this period (for version A of the models only). As shown, the movements in four variables put upward pressure on the Canadian dollar: the increase in commodity prices and in the interest rate spread, as well as the deterioration in both the US fiscal and current account balances. The only offsetting factor over this period came from the increase in energy prices, which tended to depreciate the Canadian dollar. So in contrast to the previous period, all the explanatory variables over this period, except for energy prices, were moving in such a way as to put upward pressure on the Canadian dollar. Given this, the Amano-van Norden model attributed this appreciation to the increase in both commodity prices and an increasing interest rate spread, with a small offsetting effect from energy prices and a large proportion left unexplained (as shown by the contribution of the error). The other two models suggest that it was the increase in commodity prices and the interest rate spread as well as the deterioration in the US fiscal and current account balances that explained the appreciation, with a small offsetting effect from energy prices; there is still a proportion of the appreciation that is unexplained by these models, but the contribution of the error is much smaller compared with the

Amano-van Norden model. Thus, this decomposition of the dynamic simulations suggests that multilateral adjustment effects helped to explain part of the appreciation of the Canadian dollar in 2003–04.

We also examined the out-of-sample forecasting performance of the different models. To do this, we estimated all the models using dynamic rolling regressions starting with 1973Q1–2002Q4 as the sample period, moving up one quarter each time to generate a new forecast. This enabled us to compare the forecasting performance of the competing models from 2003Q1 to 2004Q1, the period of the recent appreciation of the Canadian dollar. Figures A4.4 and A4.5 in Appendix 4 depict the actual values of the real exchange rate as well as the forecasted values produced by the different models. The models with multilateral effects generally appear to do a better job with the out-of-sample forecasting over the 2003–04 period than the Amano-van Norden equation, with the possible exception of the threshold model with the debt differential in the cointegrating vector (i.e., version B of the model). This is confirmed by the forecasting performance measures reported in Table A4.6. Indeed, the reported values for the root-mean-squared error (RMSE) and Theil coefficient suggest that the models with multilateral effects (both versions A and B) outperform the Amano-van Norden specification over the period considered. Of the two models with multilateral effects, the model without threshold effects has a superior out-of-sample forecasting performance.

Conclusion

Rapid and significant appreciations of floating exchange rates, such as that experienced by the Canadian dollar in 2003 and again in 2004, pose a number of challenges for central banks in formulating the optimal monetary policy response, if any. In particular, how the central bank should react depends critically on the underlying forces behind the appreciation.

In 2003, the evidence, based on the experience of the exchange rates of other countries, indicated that some of the appreciation of the Canadian dollar reflected a multilateral adjustment to the large US external imbalance. The US current account deficit now stands at around 6 per cent of US GDP, and given that the US economy produces 30 per cent of global output, this deficit represents a significant and ongoing adjustment hurdle for the world economy. The adjustment problem is aggravated by the fact that several important US trading partners are not allowing their exchange rates to adjust, so that more of the adjustment burden in the short run is being placed on partners such as Canada, with floating rates.

In this paper, we successfully modified the traditional Bank of Canada bilateral exchange rate equation to allow for episodes of multilateral adjustment to US imbalances. Although the bilateral equation has had success in the past in explaining movements in the Can$/US$ exchange rate—especially over the medium to longer term—by relying on non-energy commodity prices and the interest rate differential, it was unable to explain adequately the magnitude or speed of the appreciation in 2003. In particular, our primary modification was the introduction of a threshold for the US fiscal deficit that allowed the specification of the equation to change between periods in which the deficit is high (greater than 2.65 per cent of GDP) to periods in which it was low. The finding that the US fiscal deficit variable is the empirically appropriate choice for the threshold, rather than the current account deficit, is intuitively appealing, because current account deficits can occur during investment booms (e.g., the latter half of the 1990s), and such external deficits are likely to be viewed as being more sustainable at current exchange rate levels than ones caused by fiscal deficits (the twin-deficits phenomenon). Domestic private investment financed by foreign borrowing is more likely to generate returns to service the debt than is government or private consumption. We also added the US fiscal and current account deficits as explanatory variables and found that the augmented threshold model dominates the traditional model in terms of in-sample explanatory power and out-of-sample forecasting ability.

Although our findings are preliminary, the main conclusion of the paper is that during periods of large US imbalances, fiscal and external, an exchange rate model of the Canadian dollar should allow for multilateral adjustment effects. Under such circumstances, monetary policies at home (and abroad) should not try to impede the adjustment but support domestic demand in order to facilitate the adjustment of resources from traded into non-traded goods.

Our effort represents one of the first attempts to allow for multilateral adjustment in a bilateral exchange rate model. The results of the threshold model suggest that there are significant non-linearities in the determination of the real exchange rate. Future work should concentrate on testing the robustness of these preliminary findings by exploring these non-linearities further with Canadian data and data of other countries.

Appendix 1
US Imbalances in the Postwar Period and the Canadian Dollar: A Graphical Depiction

Figure A1.1
The Canadian dollar and the US current account balance

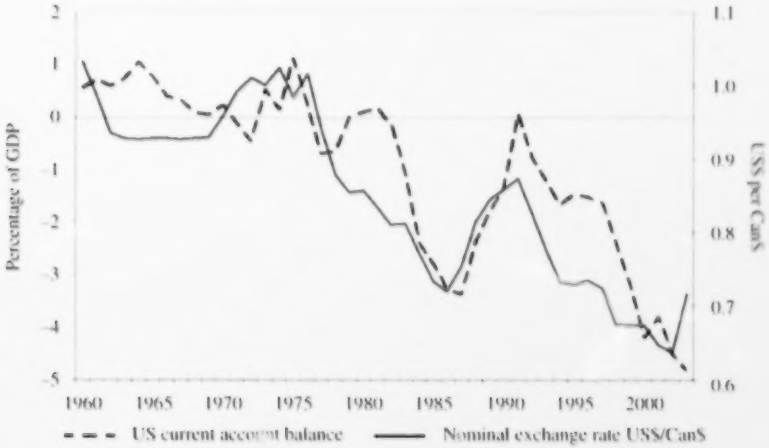


Figure A1.2
The US dollar and the US current account balance

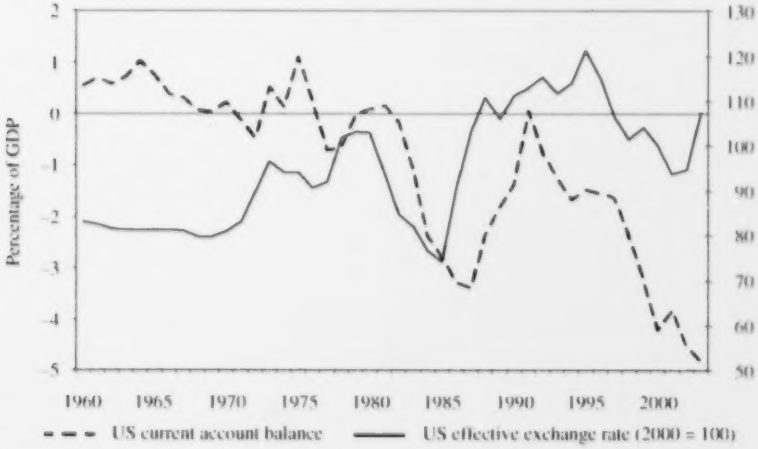


Figure A1.3
The US current account and the Canadian dollar (dynamic simulation and actual values)

Figure A1.4
The US current and fiscal account balances

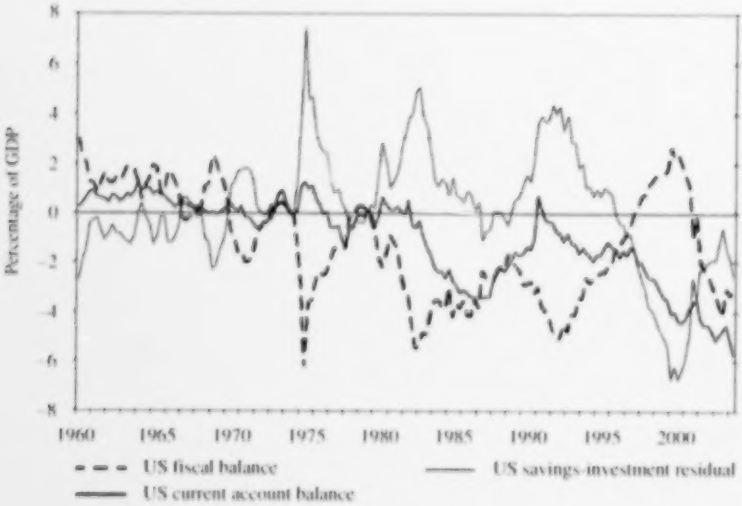
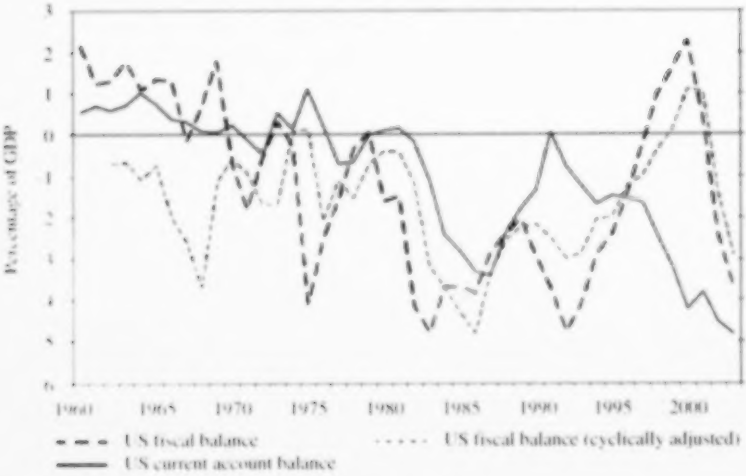


Figure A1.5
The cyclically adjusted US fiscal balance, the US fiscal balance, and the US current account



Appendix 2
Sources and Definitions of Variables

Dependent variable

1. $\Delta \ln(rfx_t)$

(Source: Bank of Canada internal database [for the nominal exchange rate], ratio of Statistics Canada series *v98086* to *v1992067* [for Canadian GDP deflator], and US Department of Commerce—Bureau of Economic Analysis series *jpgdp* [for US GDP deflator])

- log difference in the real quarterly Canada-US bilateral exchange rate constructed using the quarterly average of the noon daily spot rate, deflated by the ratio of the Canadian and US GDP deflators. Both deflators are indexed to 1997 = 1.0.

Explanatory variables

2. $\ln(comtot_{t-1})$

(Source: Bank of Canada [for nominal non-energy commodity price index, US dollar terms])

- log of the real non-energy commodity price index constructed as the nominal non-energy commodity price index deflated by the US GDP deflator.

3. $\ln(enetot_{t-1})$

(Source: Bank of Canada [for nominal energy commodity price index, US dollar terms])

- log of the real energy commodity price index computed as the nominal energy commodity price index deflated by the US GDP deflator.

4. $intdif_{t-1}$

(Source: Statistics Canada series *v122491* [for Canadian rates], and Federal Reserve Board [for US rates])

- short-term interest rate spread constructed as the difference between Canadian three-month prime corporate paper rate and US 90-day AA non-financial commercial paper closing rate.

5. $debtdif_{t-1}$

(Source: Sum of Statistics Canada series *v34422*, *v34460*, *v34584* [for total government debt in Canada], *v498086* [for Canadian GDP], and US

Congressional Budget Office [for total US government debt as a proportion of GDP])

- Canada-US total government debt to GDP ratio.

6. US_cabal_{t-6}

(Source: US Department of Commerce, Bureau of Economic Analysis series *bopcrnt* [for current account balance] and *gdp* [for GDP])

- Balance on US current account as a proportion of GDP.

7. US_fisbal_{t-3}

(Source: US Department of Commerce, Bureau of Economic Analysis series *def@gi*)

- US total government fiscal balance as a proportion of GDP.

Appendix 3
Unit-Root, Cointegration, and Weak Exogeneity Test Results

Table A3.1
DF-GLS unit-root tests
(Sample period: 1973Q1 to 2004Q1)

Variable	Trend	No trend
ln(*rfx*)	−2.38	−1.74
Δln(rfx)	**−2.96**	**−2.48**
ln(*comtot*)	−2.91	−1.45
ln(*netot*)	−1.64	−0.38
debtdif	−0.83	−1.00
Δdebtdif	−1.13	−0.89
intdif	−2.17	**−2.15**
US_cabal	−1.76	−0.22
US_fisbal	−2.38	**−2.19**

Notes:
(i) The Dickey-Fuller Generalized Least Squares (DF-GLS) test is based on Elliott, Rothenberg, and Stock's (1996) modification to the Augmented Dickey-Fuller (ADF) test. Under this test, the variable is first locally detrended/demeaned and then tested for the presence of a unit root in the usual ADF manner. The power of DF-GLS is substantially improved over the original version of ADF, particularly for finite samples. As with the ADF test, the null hypothesis states that the variable contains a unit root.
(ii) The number of lags used in the test was selected based on the Modified Akaike Information Criterion, developed by Ng and Perron (2001).
(iii) Bolded values exceed the 5 per cent critical value.

Table A3.2
Johansen cointegration test results for ln(*rfx*), ln(*comtot*), and ln(*enctot*)
(Sample period: 1973Q1 to 2004Q1)

	No trend			Trend		
No. of cointegrating vectors under H_0	**Trace statistic**	**5% critical value**	***P*-value**	**Trace statistic**	**5% critical value**	***P*-value**
Fewer than 1	18.40	29.80	0.53	42.78	42.92	0.052
Fewer than 2	07.70	15.49	0.50	12.66	25.87	0.760
No. of cointegrating vectors under H_0	**λ-max statistic**	**5% critical value**	***P*-value**	**λ-max statistic**	**5% critical value**	***P*-value**
Fewer than 1	10.72	21.13	0.67	30.12	25.82	0.01
Fewer than 2	05.33	14.26	0.70	09.41	19.39	0.68

Notes:
(i) The values reported under the column labelled "No trend" assume a constant in the cointegration space and a linear deterministic trend in the data.
(ii) The values reported under the column labelled "Trend" assume a constant and a linear deterministic trend in the cointegration space, as well as a linear deterministic trend in the data.
(iii) The number of lags used in the test was selected based on a sequential modified likelihood ratio test.
(iv) The critical values are based on MacKinnon, Haug, and Michelis (1999).

Table A3.3
Johansen cointegration test results for ln(*rfx*), ln(*comtot*), ln(*enctot*), and *debtdif*
(Sample period: 1973Q1 to 2004Q1)

	No trend			Trend		
No. of cointegrating vectors under H_0	**Trace statistic**	**5% critical value**	***P*-value**	**Trace statistic**	**5% critical value**	***P*-value**
Fewer than 1	76.28	47.86	0.00	90.58	63.88	0.00
Fewer than 2	27.29	29.80	0.09	35.72	42.92	0.22
No. of cointegrating vectors under H_0	**λ-max statistic**	**5% critical value**	***P*-value**	**λ-max statistic**	**5% critical value**	***P*-value**
Fewer than 1	48.99	27.58	0.00	54.86	32.12	0.00
Fewer than 2	14.94	21.13	0.29	22.68	25.82	0.12

Notes: See notes for Table A3.2.

Table A3.4
Weak exogeneity tests for ln(*rfx*), ln(*comtot*), and ln(*enetot*)
(Sample period: 1973Q1 to 2004Q1)

LR test statistic (no trend)	*P*-value	LR test statistic (trend)	*P*-value
3.95	0.14	3.78	0.15

Notes:
(i) The number of lags used in the test was selected based on a sequential modified likelihood-ratio test.
(ii) The likelihood-ratio (LR) test statistic follows a χ^2 (df) distribution.

Appendix 4
Estimation and Forecasting Results

Table A4.1
Estimates for bilateral exchange rate model (version A) with and without multilateral effects
(Sample period: 1973Q1 to 2004Q1)

	No multilateral effects		Multilateral effects		Multilateral effects threshold model			
	All observations				*q > –2.648*		*q = –2.648*	
Variable	**Estimate**	**Std. error**	**Estimate**	**Std. error**	**Estimate**	**Std. error**	**Estimate**	**Std. error**
speed of adj.	–0.1561***	0.0329	–0.1358***	0.0344	–0.2122***	0.0486	–0.1057**	0.0522
constant	1.7680***	0.2415	2.9429***	0.5052	2.4879***	0.2953	3.8033**	1.6974
comtot	–0.3621***	0.0455	–0.5567***	0.0940	–0.4958***	0.0583	–0.6018**	0.2741
enetot	0.0640**	0.0304	0.0376	0.0344	0.0614**	0.0286	–0.0961	0.1033
intdif	–0.6973***	0.1521	–0.5158***	0.1516	–0.4569**	0.1763	–0.7435**	0.2791
US_fisbal			0.0023**	0.0011	0.0030**	0.0015	–0.0007	0.0026
US_cabal			0.0070***	0.0016	0.0051***	0.0019	0.0087***	0.0028
R^2	0.1806		0.3044		0.3575		0.4252	
Adj. R^2	0.1540		0.2684		0.2973		0.3485	
Log-likelihood	327.26		322.90		197.64		135.12	
No. of obs.	128		123		71		52	
D.-Watson	1.17		1.44		1.60		1.39	

Note:
(***), (**), and (*) indicate statistical significance at the 1 per cent, 5 per cent, and 10 per cent levels, respectively.

Table A4.2
Estimates for bilateral exchange rate model (version B) with and without multilateral effects
(Sample period: 1973Q1 to 2004Q1)

	No multilateral effects		Multilateral effects		Multilateral effects threshold model			
	All observations				*q > –2.648*		*q = –2.648*	
Variable	**Estimate**	**Std. error**	**Estimate**	**Std. error**	**Estimate**	**Std. error**	**Estimate**	**Std. error**
speed of adj.	–0.1528***	0.0326	–0.1356***	0.0343	–0.2114***	0.0488	–0.1152**	0.0473
constant	1.0048**	0.4979	2.2141***	0.6915	2.7095***	0.4962	1.8090	2.0930
comtot	–0.[illegible]396***	0.0812	–0.4492***	0.1133	–0.5321***	0.0890	0.2071	0.3162
enetot	0.0909**	0.0357	0.0729	0.0451	0.0545*	0.0306	0.2094	0.1282
debtdif	0.0023*	0.0013	0.0020	0.0017	–0.0007	0.0011	0.0150**	0.0074
intdif	–0.6296***	0.1543	–0.4565***	0.1580	–0.5048**	0.1949	–0.6972***	0.2526
US_fisbal			0.0024**	0.0011	0.0027*	0.0016	0.0009	0.0024
US_cabal			0.0066***	0.0016	0.0051***	0.0019	0.0044	0.0028
R^2	0.2057		0.3144		0.3611		0.5409	
Adj. R^2	0.1731		0.2726		0.2901		0.4679	
Log-likelihood	329.24		323.79		197.84		140.96	
No. of obs.	128		123		71		52	
D.-Watson	1.20		1.45		1.64		1.62	

Note:
(***), (**), and (*) indicate statistical significance at the 1 per cent, 5 per cent, and 10 per cent levels, respectively.

Table A4.3
Residual diagnostic tests *p*-values (all observations)

	Multilateral effects		Amano-van Norden	
	Version A	Version B	Version A	Version B
LM(1)	0.85	0.87	0.94	0.95
LM(2)	0.15	0.17	0.41	0.40
ARCH(1)	0.41	0.55	0.17	0.30
ARCH(2)	0.65	0.82	0.19	0.44

Note: The reported values for the LM test are those for the model that includes a lagged dependent variable.

Table A4.4
Decomposition of dynamic simulation
Simulation period: 1973Q1 to 2002Q4
Contribution of each variable to explaining depreciation of real exchange rate over simulation period

Variable (direction of move in variable)	App./dep.	Amano-van Norden	Multilateral	Threshold
Commodity prices (↓)	dep.	91%	137%	128%
Energy prices (↑)	dep.	13%	7%	13%
Interest rate spread (↑)	app.	−20%	−16%	−11%
US fiscal balance (↑)	dep.		5%	3%
US current account (↓)	app.		52%	27%
Lags		2%	1%	12%
Error		18%	20%	6%
Total		100%	100%	100%

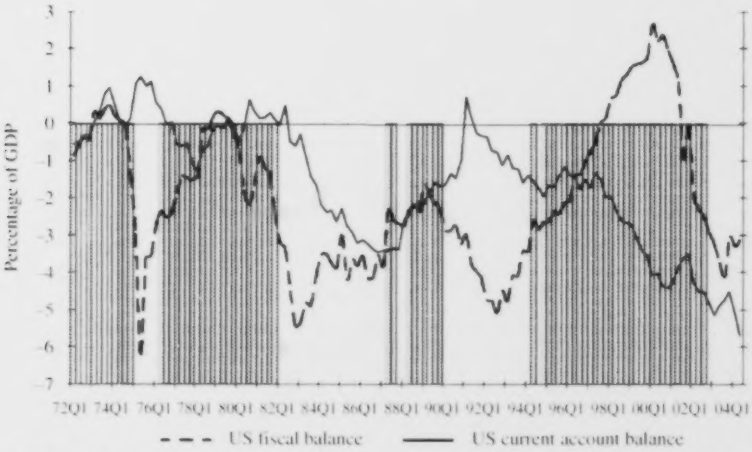
Table A4.5
Decomposition of dynamic simulation
Simulation period: 2003Q1 to 2004Q1
Contribution of each variable to explaining appreciation of real exchange rate over simulation period

Variable (direction of move in variable)	App./dep.	Amano-van Norden	Multilateral	Threshold
Commodity prices (↑)	app.	12%	16%	14%
Energy prices (↑)	dep.	−3%	−2%	−4%
Interest rate spread (↑)	app.	7%	6%	8%
US fiscal balance (↓)	app.		5%	−1%
US current account (↓)	app.		11%	13%
Lags of dependent variable		16%	23%	39%
Error		68%	41%	23%
Total		100%	100%	100%

Table A4.6
Out-of-sample forecasting performance (dynamic) using actual values for the explanatory variables
Estimation period: 1973Q1 to 2002Q4
Forecasting period: 2003Q1 to 2004Q1

	Version A		Version B	
Model	RMSE	Theil coefficient	RMSE	Theil coefficient
Amano-van Norden	0.046	0.086	0.045	0.084
Multilateral effects	0.036	0.067	0.036	0.067
Threshold model	0.043	0.078	0.044	0.080

Figure A4.1
Multilateral variables in the two regimes



Note: Shaded regions indicate periods of total government fiscal balance less than the −2.648 per cent threshold.

Figure A4.2
Dynamic simulations of competing models
Version A of models

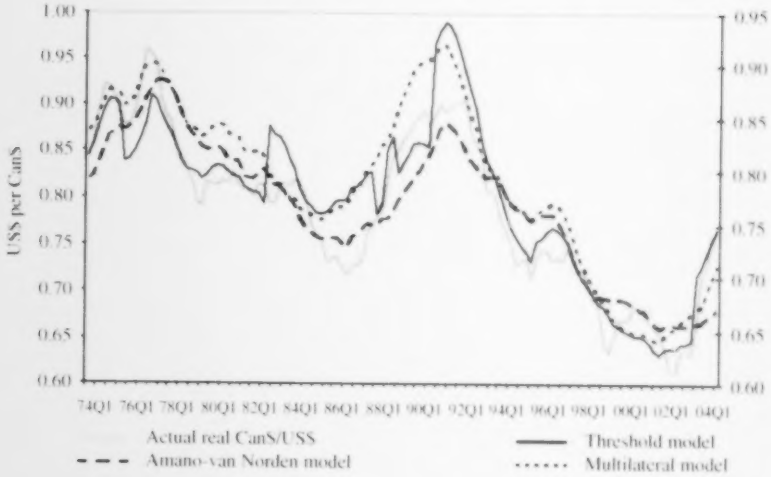


Figure A4.3
Dynamic simulations of competing models
Version B of models

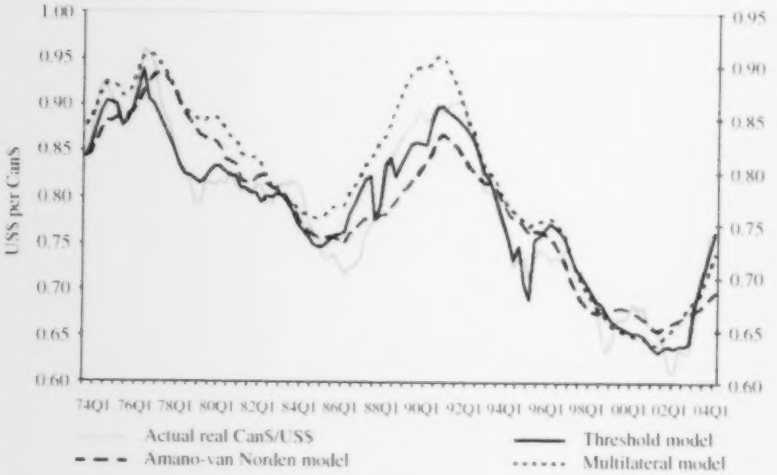


Figure A4.4
Out-of-sample performance of competing models using actual values for explanatory variables
Version A of models
Estimation period: 1973Q1 to 2002Q4
Forecasting period: 2003Q1 to 2004Q1

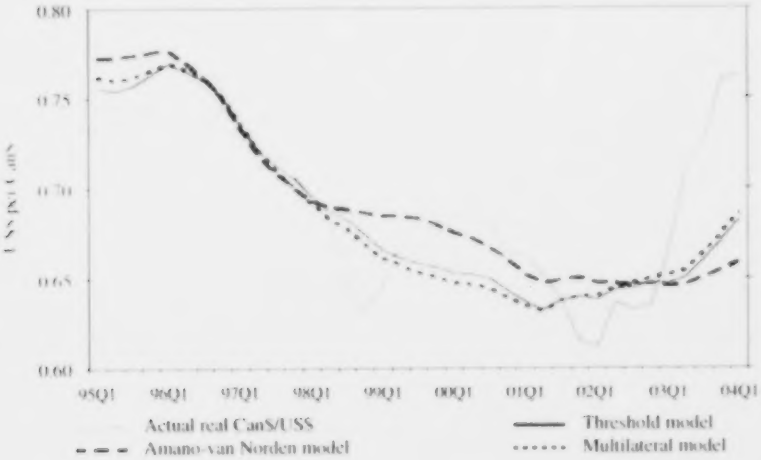
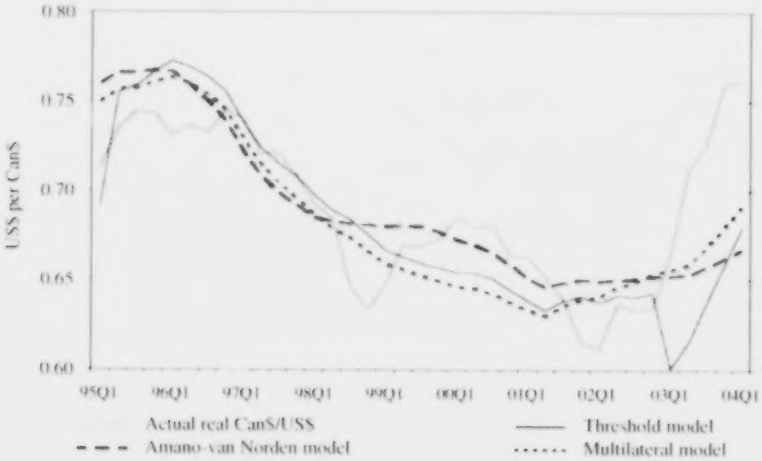


Figure A4.5
Out-of-sample performance of competing models using actual values for explanatory variables
Version B of models
Estimation period: 1973Q1 to 2002Q4
Forecasting period: 2003Q1 to 2004Q1



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Discussion

Paul Masson

Introduction

The major goals of the paper by Bailliu, Dib, and Schembri are to understand the appreciation of the Canadian dollar in 2003 and to predict its level in the future. The heretofore successful Bank of Canada exchange rate equation, termed the Amano-van Norden equation, did not predict the appreciation. This equation is driven mainly by Canada-US interest differentials and non-energy commodity prices.

The authors identify possible culprits—in particular, the omission of the US current account and fiscal deficits. They add these variables to the equation for the bilateral real exchange rate of the Canadian dollar against the US dollar, and in one version of the model, the US fiscal deficit is used as a threshold variable for dividing the sample into two subsamples, with the notion that in the case of a large deficit, the two US variables should have a significant influence in explaining appreciation of the Canadian dollar, which might not necessarily be the case when the deficit is smaller.

The authors argue that multilateral models of exchange rate adjustment justify the inclusion of the US current account and fiscal variables. When the US dollar is depreciating against all (or many) currencies, presumably as a result of large domestic and external imbalances, then naturally enough Canada will participate in the adjustment—in addition to the purely Canadian influences driving the loonie.

The authors' model, however, is not fully fleshed out. They acknowledge that a rigorous multilateral model would involve other variables (and perhaps involve estimating other equations) and be considerably more complicated. In the interest of simplicity and tractability, however, and

building on the previous work, they chose to remain with a reduced-form framework.

The Macroeconomic Balance Approach

Even if one takes this tack, it is useful to attempt to relate the reduced form to the variables that would be suggested by a more structural approach. One such model is the macroeconomic balance approach, which views the current account as the bridge between two identities—one that expresses the current account as the difference between domestic saving (in which fiscal deficits appear as dissaving) and domestic investment, and the other as the sum of the trade balance and net investment income from abroad. The first identity can be related to the usual determinants of saving and investment—interest rates, economic growth, and the fiscal position—and the second to price competitiveness and the output gap. With a little manipulation, this model can be used to create a reduced form for the bilateral real exchange rate in terms of US and Canadian variables, since third-country effects wash out under certain conditions.

Let me illustrate this approach in the case that we are considering (see box). Saving depends positively (though the sign is theoretically ambiguous) on the level of interest rates, while investment depends negatively. Saving may also involve a Ricardian offset of fiscal deficits, and investment may depend on actual or expected economic growth, as implied by the accelerator model. It is assumed that the coefficients here are the same across all countries. Looking at the international side, an improvement in the current account needs to involve a real effective exchange rate depreciation, output below potential, or both. (The role of net foreign assets in augmenting net investment income from abroad, which is also a component of the current account, is ignored, but it could easily be included here.) In the current account equation, the coefficients are not assumed to be the same across countries, since they will depend on country size and openness.

These simple equations can be manipulated to give an equation for the real bilateral Canadian dollar, by subtracting the real effective exchange rate of the Canadian dollar from that for the US dollar. Third-country effects will wash out, provided the United States' weight in Canada's effective rate calculation is equal to Canada's weight in the US calculation. This is unlikely to be the case in practice, making the exclusion of third-country effects problematic. Like the authors, however, I will proceed as if they could be excluded.

Even though simple, this multilateral framework suggests some stark differences with respect to the estimating equation in the paper.

The Macroeconomic Balance Approach

Let

I = the investment/GDP ratio,

S = the saving/GDP ratio,

y = the log of output,

$\bar{y}$ = potential output,

r = the interest rate,

F = the fiscal balance, as a ratio to GDP,

C = the current account balance, as a ratio to GDP,

$reer$ = the log of the real effective exchange rate,

p = the log of the domestic price level,

rxr = the log of the real bilateral (US dollar) exchange rate,

e = log of the nominal bilateral (US dollar) exchange rate.

Let us assume the following saving, investment, and net exports equations, for each country i:

$$S_i = a_0 + a_1 r_i - a_2 F_i + u_i$$

$$I_i = b_0 - b_1 + b_2 \Delta y_i + v_i$$

$$C_i \equiv S_i - I_i + F_i$$

$$C_i = c_{0i} + c_{1i}\, reer_i + c_{2i}\,(y_i - \bar{y}_i) + w_i \,. \qquad (1)$$

From the last of these equations, we can derive an equation for each country's real effective exchange rate in terms of its current account and output gap:

$$reer_i = [C_i - c_{0i} - c_{2i}(y_i - \bar{y}_i) - w_i]/c_{1i}. \qquad (2)$$

But the current account, in turn, can be written in terms of the interest rate, fiscal position, and rate of growth:

$$C_i = (a_0 - b_0) + (a_1 - b_1) r_i + (1 - a_2) F_i - b_2 \Delta y_i + (u_i - v_i). \quad (3)$$

In addition, we can express the real effective exchange rate in terms of bilateral real exchange rates:

$$reer_i = p_i + e_i - \sum_{j \neq i} x_{ij}\,(p_j + e_j) = rxr_i - \sum_{j \neq i} x_{ij} rxr_j,$$

where x_{ij} = weight of country j in the effective exchange rate calculation for country i (summing to one across all j), and

$$rxr_i = p_i + e_i - p_{US} \text{ and } rxr_{US} = 0 \text{ since } e_{US} \equiv 1.$$

Let us gather all of the third-country exchange rates into one variable, e_{ROW}.

Now we can express the bilateral rate in terms of the difference between Canadian and US real effective rates:

$$rxr_{CA} = reer_{CA} - reer_{US} + x_{CA,US}p_{US} - x_{US,CA}(p_{CA} + e_{CA}) + (x_{CA,ROW} - x_{US,ROW})(p_{ROW} + e_{ROW}).$$

If $x_{CA,US} = x_{US,CA} = \bar{x}$, then the third term above goes to zero and the rest simplifies to

$$rxr_{CA} = \frac{1}{1+\bar{x}}(reer_{CA} - reer_{US}). \tag{4}$$

Substituting equations (2) and (3) into equation (4) yields a reduced-form equation for Canada's bilateral real exchange rate:

$$\begin{aligned} rxr_{CA} = \frac{1}{1+\bar{x}}\{&[(a_0 - b_0 - c_{0,CA}) + (a_1 + b_1)r_{CA} + (1 - a_2)F_{CA} \\ &- b_2\Delta y_{CA} + (u_{CA} - v_{CA} - w_{CA}) - c_{2,CA}(y_{CA} - \bar{y}_{CA})]/c_{1,CA} \\ &- [(a_0 - b_0 - c_{0,US}) + (a_1 + b_1)r_{US} + (1 - a_2)F_{US} - b_2\Delta y_{US} \\ &+ (u_{US} - v_{US} - w_{US}) - c_{2,US}(y_{US} - \bar{y}_{US})]/c_{1,US}\}, \end{aligned}$$

or, more compactly,

$$\begin{aligned} rxr_{CA} = {} & d_0 + d_1 r_{CA} + d_2 F_{CA} + d_3\Delta y_{CA} + d_4(y_{CA} - \bar{y}_{CA}) \\ & + d_5 r_{US} + d_6 F_{US} + d_7\Delta y_{US} + d_8(y_{US} - \bar{y}_{US}) + z, \end{aligned} \tag{5}$$

where d_i are composite coefficients and z is a composite error term.

- Current account balances do not appear—either for Canada or for the United States.
- Both countries' fiscal variables appear, not just that for the United States.
- Additional variables are growth and the output gap, for both the United States and for Canada. Growth in Canada appreciates its real effective exchange rate, while output below potential depreciates it, *ceteris paribus*.

Re-estimating the Model

Even if one does not take the restrictions of the model too seriously, and even if one ignores third-country effects (on the basis of the argument made above), the macroeconomic balance approach suggests that there are additional variables that should enter the equation, while excluding the US current account balance in favour of its fundamental determinants. As a first attempt at estimating such a model, I tried adding Canadian fiscal and current account balances to their equation, along with their US counterparts (which are in the Bank of Canada model). They are added to the basic (non-threshold) model, in which the other explanatory variables are the interest differential, energy, and non-energy commodity terms of trade.

Interestingly enough, Canada's fiscal position (lagged three times, like the US variable) was significant—with *t*-values ranging from 2.4 to 4.3—whatever the lag selected for Canada's current account balance. The latter variable was never significant with the expected sign and sometimes had the wrong sign.

What I didn't do (lacking immediately available data) was to include the output gaps or the rate of output growth in the two countries—but this would be an obvious thing to attempt, while dropping the US current account variable in favour of its more basic determinants.

While the use of a more complicated error-correction model, estimation of a cointegrating vector, and the use of the US fiscal balance as a threshold variable are fully consistent with the general macroeconomic balance framework I have described, I have additional concerns about the paper's empirical implementation.

- The sample seems to have been divided in the same way (with the same threshold for the US fiscal balance of –2.64 per cent of GDP), whatever the other estimates of the model. Surely a complete estimation of model B would give a different threshold than that for model A. It is not clear why a two-step approach was used here.

- The test for equality of the coefficients in the two regimes (which apparently rejects the hypothesis) needs to reflect the fact that the classification of the data points is endogenous. After all, we are choosing the subsamples to maximize differences between them. This makes the critical values larger (I believe that Andrews has calculated the correct critical values).

Conclusion

I would note in closing that the out-of-sample predictive power of the threshold model is, in fact, very poor, so that instead of a price of the US dollar of Can$1.30, which we saw early in 2004, the model predicted Can$1.47. There is clearly more work to do. Or perhaps the authors, like many of the rest of us, will accept the consensus in the economics profession that structural exchange rate models are not very effective at explaining short-term exchange rate movements out of sample.

NEMO: An Equation for the Canadian Dollar

*John F. Helliwell, Ramzi Issa, Robert Lafrance, and Qiao Zhang**

Introduction

Bank of Canada staff have often found it useful, in evaluating the economic outlook, to check the predictions of a Canada-US real exchange rate equation that was originally developed by Robert Amano and Simon van Norden (1993) for RDXF, an earlier Bank of Canada macroeconomic model. This equation, which we call CPE (for Commodity Price Exchange rate), is built around a long-run relationship between the bilateral real exchange rate and real commodity prices, split between energy and non-energy components.[1] Short-run dynamics are captured by Canada-US nominal interest differentials and changes in relative government debt/GDP ratios. Significant differences between the actual and predicted value of the Canada-US nominal exchange rate, based on dynamic simulations, are

1. The traditional Keynesian RDXF (Research Department Experimental Forecasting) model was replaced by a new, forward-looking Quarterly Projection Model (QPM) in late 1993. CPE was initially developed by Amano and van Norden (1993, 1995), but was subsequently modified a number of times. Variants of CPE have figured prominently in various Bank of Canada studies: Murray, van Norden, and Vigfusson (1996); Murray (1999); Djoudad, Gauthier, and St-Amant (2001); Murray, Zelmer, and Antia (2000); and Murray, Djoudad, Chan, and Daw (2001).

* Robert Lafrance and Ramzi Issa are in the Bank's International Department. John Helliwell was the Governor's Special Adviser when this project was carried out. Qiao Zhang has since left the Bank. The authors have benefited from, and are grateful for, the numerous suggestions that they received from colleagues in writing this paper.

usually interpreted as temporary misalignments, which have a bearing on the conduct of monetary policy.

CPE has raised a number of questions, however. For instance, it implies that higher energy prices weaken the Canadian dollar, despite the fact that Canada is a net exporter of energy-related products and that the United States is a large net importer. Laidler and Aba (2001) argue that energy commodity prices played a limited role in determining the real exchange rate after the 1970s. In effect, estimated over the 1975–99 period, CPE fails to find a significant role for energy prices (see Appendix 2). And CPE cannot account for the sharp appreciation of the Canadian dollar in 2003.

In this paper, building on previous experience with CPE, we estimate a nominal bilateral exchange rate equation, which we call NEMO (Nominal Exchange rate MOdel).[2] Loyal to the Bank's traditions in this regard, our approach is a pragmatic one, based on experimenting with a small set of explanatory variables that have been related to the exchange rate in the literature.[3]

Our best version of NEMO incorporates two long-run fundamentals of the nominal exchange rate fully adjusted for national prices (or real exchange rate): real non-energy commodity prices and labour productivity differentials with the United States. This relationship is augmented by nominal variables to capture short-run dynamics: Canada-US short-term interest rate differentials, the evolution of the US dollar relative to other currencies, and a measure of risk perception in international markets. NEMO tracks the historical data well, both in sample and out of sample and can account for the sharp appreciation of the Canadian dollar in 2003.

Our main message is that NEMO can account for most of the Canadian dollar's movements since 1975. Two exceptions stand out: late 1998 when the dollar came under strong speculative pressure in the wake of the LTCM (Long-Term Capital Management) debacle, and the autumn of 2001 (and most of 2002) in the wake of terrorist acts in New York and Washington.

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2. Our focus on the nominal exchange rate comes from findings early in the project that relaxing the constraints on relative price dynamics, which are part and parcel of a real exchange rate equation, significantly helped to explain the movements of the nominal exchange rate.

3. There is a long-standing tradition in the empirical exchange rate literature of linking the exchange rate to a few key macroeconomic variables or "fundamentals." NEMO may be classified as a BEER equation. BEER stands for Behavioural Equilibrium Exchange Rate. The "equilibrium" label refers to the fact that the exchange rate reflects estimated historical linkages with the fundamentals. It does not mean that the estimated exchange rate from the single-equation model is necessarily at a value that would close the output gap. For a review of BEER and related concepts, see MacDonald (1999 and 2000).

The implication of our findings for monetary policy is that the monetary authorities in their deliberations should assume that the Canadian dollar reflects economic fundamentals, except in extraordinary circumstances when exchange markets are obviously disrupted.

The outline of our paper is as follows. After discussing candidate variables (section 1), we establish the statistical properties of the variables and the conditions that allow us to adopt a single-equation approach (section 1.1). We then report our estimation results (section 1.2), as well as robustness and predictability tests (section 1.3). In section 2, we discuss possible interpretations of the effect of productivity differentials on the exchange rate and conclude in section 3 with leads to further research.

1 Finding NEMO

1.1 Specification

Like CPE, NEMO is an error-correction model (ECM). NEMO is built around a long-run cointegrating relationship between the nominal exchange rate, a proportional change in relative prices, and a set of other long-run fundamentals. Short-run dynamics are captured mainly by Canada-US short-term interest rate differentials and other nominal variables.

In more formal terms:

$$\Delta e_t = \phi(e_{t-1} - p_{t-1} - \Pi X_{t-1}) + \Gamma \Delta Z_t + \varepsilon \qquad (1)$$

e: logarithm of the nominal Can$/US$ exchange rate;
p: logarithm of the ratio of Canada/US GDP deflators;[4]
X: set of long-run fundamentals;
ΔZ: set of short-run dynamics;
ϕ is the adjustment coefficient; Π and Γ are vectors of coefficients; and
ε: error term.

In the long run, the bilateral exchange rate will adjust to fully account for Canadian and US inflation differentials and underlying fundamentals that are likely to affect aggregate demand and the trade balance. Thus, we impose (and confirm by tests) a unit coefficient on the price differential

4. We use GDP deflators rather than CPI, because the real exchange rate ultimately balances aggregate demand and supply in an open economy. Thus, prices should be considered from a production, rather than a consumption, perspective.

(p).[5] In other words, in the long run, the real exchange rate $(e - p)$ will adjust to its fundamentals (X).

For the long-run fundamentals, we looked to the major components of Canada's international trade: commodities and manufactured goods. (Variable definitions and sources are listed in Appendix 1.) Commodity prices are quite volatile when compared to prices of manufactured goods, and this volatility is likely to be reflected in real exchange rate movements. Higher prices for commodities that Canada exports represent a positive terms-of-trade shock that requires a real appreciation to re-establish equilibrium. The relationship between the real exchange rate and real non-energy commodity prices (*com*) is evident in the data (Figure A3.3). Given previous findings with CPE, we did not see a role for energy commodity prices.

In the case of manufactured goods, which represent the greater part of traded goods between Canada and the United States, relative productivity (*pmg*) growth should be an important factor. There are two ways to look at the effect of productivity on the exchange rate. The first is a relative supply effect. In a two-country model, the country that experiences higher relative productivity growth will incur a real depreciation, since this is required to increase sales abroad. This assumes that firms are not price-takers in international markets (or that price elasticities for exports are not infinite). An alternative interpretation is the Balassa-Samuelson hypothesis or BSH (Balassa 1964; Samuelson 1964).[6] This hypothesis states that countries where productivity growth in the traded goods sector, relative to other sectors, is greater than that of their trading partners, will experience a real appreciation over time. The reason is that wages in the more productive economy, and therefore prices, will rise faster to reflect the productivity increases.[7]

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5. How much prices adjust is not considered in this paper. While not conclusive, a comparison of the variances of the nominal exchange rate (0.0163) and of the relative prices (0.0016), over the 1975–99 period, suggests that the nominal exchange rate was responsible for most of the real exchange rate adjustment that was required by the fundamentals. Consequently, the bilateral nominal and real exchange rates tend to move together (Figures A3.1 and A3.2).

6. BSH assumes that: (i) labour is the only factor of production; (ii) labour is mobile between sectors within a country, such that wages are equalized across sectors within a country; (iii) shares of non-traded goods are the same in both economies and constant over time; and (iv) purchasing-power parity (PPP) holds in the short run for traded goods.

7. In more formal terms, if we define labour productivity at home (abroad) in traded goods as $JT(JT^*)$ and correspondingly labour productivity in the aggregate economy as $JA(JA^*)$ and the following ratio: $A = [JT/JA][JT^*/JA^*]^{-1}$, then BSH says that an increase in A implies a real appreciation. In effect, the aggregate economy can be viewed as a proxy for non-traded goods (i.e., non-manufacturing), since the manufacturing sector accounts for about 20 per cent of GDP in Canada and in the United States.

For the short-run dynamics, we consider initially interest rate differentials (i), changes in relative GDP as a cyclical proxy (Δgdp), as well as changes in the effective US dollar nominal exchange rate (Δusd), excluding Canada.[8] The interest rate ratio is lagged one period to reduce the risk of simultaneous equations bias. To the extent that a US-dollar depreciation reflects the process of global adjustment, the Canadian dollar will also tend to appreciate. As for the relative cyclical variable (Δgdp), the presumption is that relatively stronger growth in Canada will result in an appreciation of the Canadian dollar (to counteract aggregate demand pressures).

We also examine, in a second stage, the possible contribution of selected financial market variables, such as the US current account deficit as a proportion of nominal GDP (uca), Canadian versus US stock market prices (sm), international risk premiums (yus), and the Canadian-US federal government fiscal deficit differential (df).[9] As these factors will encourage capital flows into Canada, we expect interest rate spreads in Canada's favour and relatively better performance of Canadian stock markets to appreciate the Canadian dollar. Factors that are also considered favourable for the Canadian dollar, by reducing the currency premiums, are a lower international risk premium, a relatively better fiscal balance in Canada than in the United States, and a worsening of the US current account balance (which implies the need for a US-dollar depreciation).

To allow for testing the robustness of the equation and to limit the temptation of data mining, the sample period, 1975Q1 to 1999Q4 or 100 observations, was chosen a priori. The starting point was chosen to allow markets to settle down after the major shocks that were experienced in 1973. They include the large, unexpected oil-price shock in the autumn of 1973, the breakdown of the Bretton Woods pegged exchange rate arrangement in 1973, and a structural break in trend productivity in industrial countries around 1973. In our judgment, too many factors were at play in 1973–74 to get a good grasp on exchange rate fundamentals. The end point was chosen to allow for four years of post-sample experience in order to assess the

8. We also considered the contemporaneous inflation differential, i.e., Δp. We discarded this variable, however, for two reasons. First, its coefficient was of the wrong sign (higher inflation in Canada pointed to an appreciation of the Canadian dollar), which we could not explain to our satisfaction. Second, we wanted to avoid the risk of simultaneous equations bias.

9. The relatively more favourable performance of stock markets across the border seems to be reflected in a lower Canadian dollar since the mid-1980s (Figure A3.8). The US current account deficit as a proportion of US nominal GDP also seems to parallel the evolution of the bilateral exchange rate in the sense that growing deficits are associated with a stronger US dollar in bilateral terms (Figure A3.9).

forecasting performance of the equation. The relevant data for the explanatory variables are plotted in Figures A3.3 to A3.11.[10]

1.2 The error-correction framework: testing stationarity, cointegration, and weak exogeneity

First, we need to ascertain the order of integration of the variables to ensure that our estimated equations are balanced.[11] To do this, we use the modifications of the augmented Dicky-Fuller (1979) (ADF) and the Phillips-Perron (1988) (PP) tests that have better finite-sample properties. Elliott, Rothenberg, and Stock (1996) suggest detrending the variables via a generalized least squares (GLS) regression before performing the ADF test. Ng and Perron (2001) also apply the GLS procedure to detrend the variables and modify the PP tests statistics using a method suggested by Stock (1999) that corrects for possible size distortions in the presence of negative moving-average errors. We perform both tests under the general-to-specific sequential testing procedure suggested by Campbell and Perron (1991). Reported in Table A3.1, the results indicate that series *e*, *com*, *pmg*, *usd*, *p*, and *yus* appear to have a unit root, while *i* appears to be mean stationary.

Second, we need to determine whether the I(1) variables of interest *e*, *p*, *pmg*, and *com* are cointegrated. The Engle-Granger (1987) method applies a unit-root test to the residuals of the candidate cointegrating vector. Our tests suggest that we cannot reject the null hypothesis of no cointegration at the 10 per cent level using the appropriate critical values (Table A3.2).[12] The Engle-Granger method, however, lacks power in identifying short-term dynamics. One solution to this problem is to use an ECM test, which is based on the Granger representation theorem that says there is an error-correction representation for every cointegrating relationship. Boswijk and Franses (1992) and Boswijk (1994) propose such a test. A single conditional ECM is estimated under three assumptions: (i) there is at most one

10. Following the conference, we updated the data in the figures from 2003Q4 to 2004Q3.

11. Formally, a variable is said to be an integrated series of order d, denoted I(d), if it can be represented by a stationary and invertible autoregressive moving-average (ARMA) process once it has been differenced d times. The variable is also said to have d unit roots.

12. The standard Dickey-Fuller tables from the unit-root tests may only be used if values of the cointegrating vector are imposed. Since the error term is estimated from a process that minimizes the sum of squared residuals, the cointegration test would be biased towards finding a stationary process using the standard Dicky-Fuller distribution. One consideration affecting the distribution of the appropriate critical values is the number of I(1) variables in the cointegrating relationship. Although four variables define our cointegrating relationship, a unit coefficient for p is imposed. Thus, our equation reduces to estimating a three-variable cointegrating relationship defined by $(e_t - p_t) = \Pi X_t + \varepsilon$ from equation (1) and applying the unit-root tests on the estimated residuals.

cointegrating vector; (ii) the variables of interest (here *p*, *pmg*, and *com*) are weakly exogenous; and (iii) the residuals are normally distributed.[13] A Wald-type test is performed to measure the significance of the long-run relationship in the ECM. The results indicate that a cointegrating relationship exists at the 5 per cent level (Table A3.2).

Our final test for cointegration is the system approach of Johansen and Juselius (1990), which has the advantage of determining the number of cointegrating vectors while making no assumptions of exogeneity. Moreover, we can test assumptions specified in equation (1). We begin by estimating an unrestricted vector autoregressive (VAR) system of equations with variables *e*, *p*, *pmg*, and *com*. The results point to the presence of a single cointegrating vector (Table A3.2).[14] To check if the relative price term (*p*) has a unit coefficient, we test the assumption that the coefficients of *e* and *p* are equal with opposite signs in the cointegration space. The likelihood-ratio test statistic of 1.25 follows a $\chi^2(1)$ distribution with a *p*-value of 0.26, indicating that this restriction is not rejected.

For NEMO to be estimated as a single error-correction equation, we need to verify the condition of weak exogeneity for our cointegrating variables (Johansen 1992).[15] Under the assumption of one cointegrating vector and imposing the linear restriction that the coefficients for *p* and *e* are equal with opposite sign in the cointegration space, the likelihood-ratio test statistic of 4.67 has a $\chi^2(4)$ distribution with a *p*-value of 0.32. This suggests that weak exogeneity is satisfied and our single-equation specification for NEMO is valid.

1.3 Estimation results

Our various equations are estimated by the non-linear least-squares approach of Phillips and Loretan (1991). This approach allows us to estimate both the long- and short-run relationship and use standard inference to test hypotheses about the parameters in Π and Γ—though not ϕ—in equation (1).

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13. The variables are weakly exogenous in the sense of Engle, Hendry, and Richard (1983). This is verified below.

14. To check if the exchange rate (*e*) is part of the cointegrating relationship, we excluded it from the cointegration space and repeated the test. In this case, we could not find a cointegrating relationship at any conventional level of significance.

15. A cointegrating variable τ fails to be weakly exogenous if the error-correction mechanism appears in some other equation determining τ. As formulated by Johansen and Juselius (1990), the test of weak exogeneity is a test on whether components of the adjustment matrix Ψ, ψ_i, associated with *p*, *pmg*, and *com*, are equal to zero.

From Table A3.3, EQ1 includes two long-run determinants for the real exchange rate $(e - p)$: relative labour productivities (*pmg*) and real non-energy commodity prices (*com*). For the short-run dynamics, two variables were retained: the lagged nominal interest rate differential (i), and the US dollar effective exchange rate excluding Canada (*usd*). In the latter case, our assumption is that part of the overall US dollar adjustment to its fundamentals is reflected in the bilateral Canadian dollar exchange rate (i.e., the coefficient on Δusd should be positive).[16] EQ1 says that higher productivity growth in manufacturing than in the aggregate economy in Canada, relative to the United States, leads to a depreciation of the real exchange rate. To the extent that we associate manufacturing more with traded goods, the sign of the coefficient of *pmg* is opposite of what BSH would predict. It is not inconsistent, however, with new open economy macroeconomic models (see section 2 for a discussion). Positive productivity shocks will tend to induce a real exchange rate depreciation to raise aggregate demand to the higher output potential. In a flexible exchange rate regime, most of the adjustment will come from changes in the nominal exchange rate.

The finding that relatively higher productivity growth in the Canadian (US) manufacturing sector tends to depreciate the Canadian (US) dollar is quite robust.[17] In EQ3, only productivity differentials in manufacturing are considered (rather than as a ratio of aggregate productivity) and we still find a negative relationship between productivity and the external value of the currency.[18] The effect is also present for broader measures of productivity, though neither GDP per employee (EQ4) nor GDP per capita (EQ5) was found to be significant at the conventional levels. If we split the two relative productivity measures into manufacturing and aggregate productivity, their coefficients are of opposite signs, though the aggregate productivity measure is not significantly different from zero at conventional levels (EQ6).

Estimation results with additional financial variables are reported in Table A3.4. Most of the financial variables that are considered add little to the fit of the equation. US current account deficits are not significantly related to the Canadian dollar (EQ8).[19] The coefficient on Δsm is

16. While it is possible to improve on EQ1 by including changes in the Canada-US GDP ratio (EQ2), concerns about endogeneity led us to drop this variable.

17. Some have suggested, and this does not contradict our results, that the main "driver" of *pmg*, at least since the mid-1990s, has been the surge in US manufacturing productivity growth.

18. Note that other definitions of *pmg* would entail different rationales to motivate the inclusion of the relative productivity term in the exchange rate equation.

19. Bailliu, Dib, and Schembri (2005) are more successful with a non-linear relationship that includes threshold effects.

significant and of the expected sign (EQ9). Faster rising stock market prices in Canada lead to an appreciation of the Canadian dollar, but the effect is quite small. Relative federal government budget balances are not significant (EQ10), nor is there an obvious relationship in the data apart from the 1990s (Figure A3.10). In contrast, the emerging-market risk-premium variable (*vus*) that we introduce is highly significant and of the expected sign (EQ11). Our assumption, based on anecdotal evidence, is that Canada gets sideswiped in periods when investors in international markets are more risk-averse or seek safer havens. Higher risk premiums on emerging-market bonds are assumed (and found) to be a negative for the Canadian dollar, though it is not immediately apparent from the data (Figure A3.11). EQ12 indicates that the risk-premium indicator is preferred to the stock market variable.

Among the equations that we considered, EQ11 is the best candidate for NEMO. All its coefficients are significant at the 1 per cent level and of the correct sign. (The sign on the productivity variable is consistent with models that take into account price rigidities, imperfect competition, and preferences favouring local goods.) The Lagrange Multiplier test does not indicate any serial correlation of the residuals, and the White (1980) test suggests no heteroscedasticity problem (Appendix 3). Moreover, the fit is quite good.

Ceteris paribus, the coefficients of NEMO indicate that:

- it takes about four and a half years for the real exchange rate to adjust to its fundamentals;[20]
- higher real commodity prices strengthen the Canadian dollar;[21]
- faster labour productivity growth in manufacturing in Canada than in the United States tends to depreciate the currency—and vice versa for aggregate productivity growth;
- a 100 bp increase in interest rate differentials in Canada's favour will lead to a 2 per cent appreciation of the Canadian dollar in the short run; and

20. In effect, 90 per cent. This is based on the following formula: $\phi t = \ln(1 - P)$, where ϕ is the adjustment coefficient, t is the number of quarters, and P is the proportion of the gap between the actual and equilibrium real exchange rate according to its long-run fundamentals that is closed. In this case, $P = 0.90$ and $t = 17.7$. After two years, about two thirds of the gap is closed.

21. As major movements in the US dollar will tend to affect commodity prices (since commodity price fluctuations are magnified for the other major economies), we checked whether *usd* and *com* were strongly correlated. We found no significant correlation between these two variables up to four leads or lags. See Appendix 3 for details.

- on average, about 10 per cent of US-dollar movements relative to other currencies will be reflected in the bilateral exchange rate, in the short run.

NEMO can account for the appreciation of the Canadian dollar from the beginning of 2003 to the third quarter of 2004 (Figure A3.12). The contribution of each explanatory variable in NEMO is plotted in Figure A3.13 (for the long-run cointegrating terms) and Figure A3.14 (for the short-run dynamics). According to NEMO, over the past two years, the main factors underlying the appreciation of the Canadian dollar were rising commodity prices (*com*), the depreciation of the US dollar against other major currencies (*usd*), and a lower international risk premium (*yus*). Other factors had only a marginal impact. Over the 1975–2004Q3 period, a decomposition shows that the main factor that contributed to the depreciation of the Canadian dollar was the decline in real commodity prices (Figure A3.15), while interest rate differentials played a major, though temporary, role in supporting the currency around 1990 (Figure A3.16).

1.4 Robustness and predictability

To gauge the robustness of NEMO, we did rolling regressions with a fixed window of 50 observations (Figures A3.17 to A3.22; the date in the charts refers to the last data point in the sample). Two things stand out in these charts. First, the coefficients appear to be stable, as there is no indication of coefficients changing signs, and the range of variation of the estimated coefficients seems to be within the conventional standard errors. Second, the Russian/LTCM episode has a large, temporary impact on the value of the coefficients, suggesting that this period was an "outlier" in the data. We also report estimates of NEMO's coefficients for various sample lengths (including post-1999 data) in Table A3.5, running from 60 to 116 observations. As can be seen, NEMO does well in all sample periods.

Based on a dynamic simulation that starts in 1975 (Figure A3.23), we can conclude that NEMO tracks the historical data well. NEMO is unable to explain the weakness of the Canadian dollar in late 1998 and 2001, however. In both cases, special factors that are not captured in the model were at play. In the summer of 1998, the Canadian dollar came under pressure in the wake of the Russian currency crisis and the collapse of LTCM. This led to abandoning the official policy of intervening on the exchange market to temper daily variability. In September 2001, terrorist attacks in New York and Washington affected the US and Canadian financial systems for a short while, and the Canadian dollar depreciated as capital flowed into the United States.

Before evaluating NEMO's forecasting ability, we need to establish the condition of strong exogeneity by testing the null hypothesis that variables *p*, *pmg*, and *com* in our VAR system do not Granger-cause *e*. Toda and Yamamoto (1995) have established that we can formulate this test in a VAR level representation even with integrated or cointegrated processes, as long as the order of integration does not exceed the true lag length. Since our maximal order of integration is one, we can proceed to test for Granger causality in the usual manner by estimating our VAR with two lags and testing whether the coefficient matrices associated with *p*, *pmg*, and *com* of the first lag are equal to zero. The likelihood-ratio test statistic of 1.25 follows a $\chi^2(3)$ distribution with a *p*-value of 0.74 and allows us to conclude that strong exogeneity is satisfied.

Following the methodology of Meese and Rogoff (1983), we compare NEMO's out-of-sample forecasting performance to a random walk with drift (RWD). We estimate NEMO on data up to the fourth quarter of 1994 and then generate forecasts at one-, four-, eight-, and sixteen-quarter horizons, using the realized values for the explanatory variables. We repeat this process moving one period forward, while maintaining the number of observations fixed, until 2003Q4. The calculated forecast errors are reported as mean absolute error (MAE), root-mean-square error (RMSE), and Theil's U-statistic (THEIL) in Table A3.5. Based on all three criteria, NEMO outperforms the RWD at the one-, four-, eight-, and sixteen-quarter horizons.

2 Discussion: Productivity and the Exchange Rate

Benigno and Thoenissen (2002) provide some insight into our result that higher relative productivity growth in Canada in the manufacturing sector relative to the aggregate economy incurs a real depreciation. They propose a two-country, sticky-price model of real exchange rate determination, which allows for deviation from PPP, both in the short run and in the long-run steady state. The model is calibrated to the United Kingdom and euro-area economies. The authors test if supply-side improvements since 1996 in the United Kingdom can account for the pound's appreciation. In their model simulations, however, improvements in productivity and increases in competitiveness are associated with a depreciation in both the spot and the equilibrium real exchange rates. The only case where a real appreciation occurs is when an increase in productivity is anticipated but has not yet occurred. The increase in perceived permanent income results in greater demand today (relative to supply) and a real appreciation. In the case of the productivity shock in the traded goods sector, a preference for local goods dominates the Balassa-Samuelson effect. In the case of an improvement in

competitiveness in the domestic market, the market segmentation channel (as PPP does not hold) dominates.

Ambler, Dib, and Rebei (2003), or ADR, shows that the direction of the effect depends on the persistence of the productivity shock. They present an estimated structural model of a small open economy with optimizing agents and nominal rigidities. The model is an extension of the calibrated model in Dib (2003). The ADR model is estimated using quarterly data for Canada and the United States. These models show that a temporary (permanent) positive technology shock induces a real exchange rate depreciation (appreciation) in the long run. Simulations with the International Monetary Fund's new Global Economic Model (GEM) indicate that positive productivity shocks in traded goods in the home country result a real appreciation of the currency (Hunt and Rebucci 2003).[22,23] The emergence and magnitude of the Balassa-Samuelson effect in GEM depend on the specific parameterization of the model.[24] The appreciation of the exchange rate owing to the Balassa-Samuelson effect stems from the presence of the non-tradable sector, combined with perfect labour mobility between the two sectors, which equalizes their nominal wages.[25] In a version of the model without non-tradable goods, however, the real exchange rate must depreciate to create the demand needed to absorb the additional supply of home tradable goods.

As noted above, our results are not consistent with the BSH interpretation. We are skeptical, however, of the BSH for two main empirical reasons. First, the international correlation between the real exchange rate and real GDP per capita, which has been strong among OECD and Asian countries

22. GEM is a new open economy macroeconomics (NOEM) model with specific micro foundations. Short-run demand determination of output originates from costly price and wage adjustment and monopolistic competition. It is a multi-good model with a distribution sector, in the mould of Corsetti and Dedola (2002), inducing market segmentation and endogenous, incomplete pass-through.

23. In Corsetti and Dedola (2002), productivity improvements in tradable goods at home generate a real depreciation. The effect works through the terms-of-trade effect, subject to the pricing decisions of firms.

24. To explain the appreciation of the US dollar and the magnitude of the deterioration of the trade balance, Hunt and Rebucci have to introduce uncertainty in their rational-expectations mechanism and assume that the risk premium on US assets has fallen substantially.

25. To further confuse the issue, Lee and Tang (2003), based on panel estimates of ten Organisation for Economic Co-operation and Development (OECD) countries, find a positive relationship between the exchange rate and productivity when productivity is measured by labour productivity. However, with total factor productivity, they find that an improvement in productivity, while not statistically significantly related to the real exchange rate, sometimes points to a real depreciation.

(Helliwell 1994, 22), but not within other groups of developing countries, is based on differences in productivity levels that are found almost equally among tradables and non-tradables. Second, if and when countries get on a convergence path of income growth that is higher than in the richer countries, productivity growth is higher in both tradables and non-tradables. Although the evidence supports the broad notion that countries often achieve higher real exchange rates as their average productivity levels converge to those of the richer countries, this high productivity growth is found throughout the economy. Thus, it seems to us unpromising to attempt to explain this convergence in terms of relative productivity growth that is higher in manufacturing.

For example, comparing two developed countries, while Canada's labour productivity growth has not kept pace with the United States, the widening gap over the 1990s was much smaller for the economy as a whole than in the manufacturing sector. Tang and Wang (2004) show that the differences are attributable to the fact that the importance of the manufacturing sector declined over the past twenty-five years or so. They estimate the contribution of various sectors to aggregate productivity growth and show that the service sector in the United States experienced higher labour productivity growth and a larger increase in its relative size than in Canada. In the manufacturing sector, the United States had much higher productivity growth than in Canada, but this was offset by a larger decline in relative size.[26]

The key error of assumption in BSH, which tends to drive the results, is that PPP always holds in tradable goods.[27] If goods and tastes differ by country, and if local producers are systematically better at recognizing and providing for local tastes, then it is possible to turn BSH on its head, as shown by Benigno and Thoenissen (2002). In this model, higher general increases in

26. Data constraints limit their analysis to the 1987–98 period. Over this time, Canada's labour productivity for the total economy increased by 12.0 per cent. Services contributed 12.4 percentage points (pp), manufacturing 2.1 pp, while the primary sector (–1.2 pp) and construction (–1.2 pp) made negative contributions. In the United States, aggregate labour productivity increased by 15.1 per cent, all attributable to productivity increases in services (15.64 pp), as the contribution of other industrial sectors was marginal: primary (-0.84 pp), construction (0.34 pp), and manufacturing (–0.07 pp).

27. Canzoneri, Cumby, and Diba (1999), using a panel of OECD countries, find that PPP between traded goods does not hold when the US dollar is the reference currency. (It does better with the D-mark.) A number of studies have shown that PPP does not hold for traded goods. For a survey of these issues, see Rogoff (1996). This has led to new models that highlight the importance of local currency pricing or pricing-to-market behaviour to explain, among other things, low degrees of estimated exchange rate pass-through to domestic prices.

productivity could lead to a higher real exchange rate (as shown by much of the international data), but an increase in relative productivity growth in manufacturing might be expected to lead to a real depreciation.

In summary, our results suggest that relative productivity in the manufacturing sector is capturing a supply effect in markets where Canadian firms are not price-takers. At the same time, when Canada's overall productivity grows faster than across the border, its real exchange rate appreciates, because this is a sign that its economy has relatively better prospects. While our results invalidate BSH, they are not inconsistent with models that take into account price rigidities, imperfect competition, intermediate goods, and preferences favouring local goods.

Conclusion

While NEMO tracks the historical data quite well, this does not mean that the path of the fitted values, either of the static or dynamic simulations, or of the path described by the cointegration term, represents the equilibrium value of the exchange rate. The real exchange rate is at its equilibrium value when the economy has reached both internal and external balance or equilibrium. Since NEMO does not depend on measures of internal and external disequilibrium, there is no reason why its fitted values should correspond to some notional equilibrium for the economy. What NEMO represents is a strong link between key variables, such that systematic deviations of the Can$/US$ exchange rate from the predicted path of the equation would tend to correct themselves over time.

NEMO is best viewed as an evolutionary step in what has been a series of Bank of Canada exchange rate equations that have used the same basic framework. Like its predecessors, NEMO does not yet adequately reflect either the causes or the consequences of large and sustained moves of the US dollar against all currencies. The inclusion in NEMO of the exchange rate between the US dollar and all other currencies is intended as a move in the right direction, but those changes are not explained, and do not attract a large enough coefficient to permit our equation for the bilateral rate to account fully for any global change in the US dollar that derives from influences other than those in our equation.

The biggest improvements in the fit and forecasting properties of NEMO, relative to its predecessors, flow from the new modelling of the effects of productivity changes, and from re-specifying the dynamics to involve changes in the nominal exchange rate as the dependent variable. We continue to use bilateral interest rate differentials as an important determinant of the dynamic adjustment of the exchange rate towards an

equilibrium real exchange rate defined in terms of relative commodity prices and productivity levels.

Our results for the effects of productivity differentials support the recent modelling and UK results of Benigno and Thoenissen (2002), among others, based on differentiated products and preferences favouring local goods, both of which are consistent with work by ourselves and others on the importance of national differences in networks and tastes. NEMO may embody the positive correlation between real per capita incomes and real exchange rates that is so evident across countries at very different levels of per capita income, but only to the extent that the productivity increase is relatively greater in the aggregate economy than in the manufacturing sector (as compared to partner countries). We are not surprised that our data do not support the Balassa-Samuelson hypothesis, since the global facts are more naturally explained by productivity levels that are lower in all industries in poorer countries.

Appendix 1
Definitions of Variables

Note: All variables are expressed as quarterly averages and in natural logarithms.

e: Can$/US$ exchange rate. Noon rate, Canadian interbank money market.

p: ratio of Can/US GDP deflators (1997 = 1).

For Canada, the ratio of GDP at market prices to GDP in chained 1997 dollars. Statistics Canada series *v98086* and *v1992067*, respectively. For the United States, 2000 chained GDP deflator, series *jpgdp*[1] from the US Department of Commerce, Bureau of Economic Analysis, rebased to 1997 = 1.0.

pmg: Can/US labour productivity indexes (1997 = 1).

(a) Manufacturing labour productivity (output per hour), seasonally adjusted (SA).

For Canada, the series are constructed with Bank for International Settlements series *m.uqnaca92*—a Bank of Canada calculation of output in constant 1992 dollars per employed person in manufacturing using the Standard Industrial Classification (SIC), which was then converted to chained 1997 dollars and seasonally adjusted using the Seasonal Adjustment, Bell Labs (SABL) decomposition method—for all periods prior to 1991. For all subsequent periods, a series was constructed with Statistics Canada series *v2036171*—manufacturing output in chained 1997 dollars using the North American Industry Classification System (NAICS)—divided by *v1596771*—all employees in manufacturing using the NAICS. Manufacturing output per hour is then computed by splicing the two manufacturing output per employee series and dividing by the Bank of Canada's calculation for the seasonally adjusted average actual hours worked per week in manufacturing. Note that for all periods after 1997, Statistics Canada series *v21573740* closely approximates and is computationally equivalent to the constructed series and therefore is used to facilitate adding future observations. For the United States, we use the series *jq%mhm* from the US Department of Labor, Bureau of Labor Statistics, consistent with NAICS.

(b) Real GDP per employee (SA).

1. All series code for the United States as found in Global Insight databases.

For Canada, total employment constructed with Statistics Canada series *v3437441*—estimates of total employment in all industries using the NAICS and seasonally adjusted using SABL—for all periods after 1976 and a Bank of Canada calculation for all prior periods. For the United States, real GDP constructed with nominal GDP series *gdp* from the US Department of Commerce, Bureau of Economic Analysis and US GDP chained price index total civilians employed given by series *ehhc* from US Department of Labor, Bureau of Labor Statistics.

(c) Real GDP per capita (SA).

Total population estimates from Statistics Canada series *v1* and US Department of Commerce, Bureau of Economic Analysis series *npbea*, respectively.

com: Real non-energy commodity price (US dollar terms) index (1997 = 1).

Bank of Canada's nominal non-energy commodity price index (US dollar terms), Statistics Canada series *v36383* divided by US GDP chained price index.

i: Can/US nominal interest rate ratio; $(1 + i_{Can})/(1 + i_{US})$. For Canada, we use the three-month prime corporate rate, Statistics Canada series *v122491*. And 90-day commercial paper rate (AA rated non-financial closing rate) from the US Federal Reserve website. Both series expressed as quarterly rates.

usd: US nominal effective exchange rate excluding Canada (1997 = 1).

Constructed as $(jrxwmcns/(e)^{0.20})^{1.25}$, where series *jrxwmcns* is the weighted average of the foreign exchange value of the US dollar against an index of major currencies from the US Federal Reserve System.

uca: US current account balance as a percentage of US nominal GDP.

Current account balance series *bopcrnt* from US Department of Commerce—Bureau of Economic Analysis.

sm: Can/US stock market prices (1997 = 1).

TSX composite (300) index of monthly closing prices from Statistics Canada series *v122620*. Standard and Poor's Corporate 500 index of monthly average prices from the *Federal Reserve Bulletin*.

yus: International high-yield bond spreads.

Data available from 1994. Weighted average of Mexico and Brazil high-yield bond spreads given by the J.P. Morgan Emerging Markets Bond Index.

Weights computed as the sample period average of nominal GDP (US dollar terms). For Mexico, nominal GDP and Mexico/US exchange rate given by International Monetary Fund series *q.27399b.czf...h* and *q.273.wf.zf...h*. For Brazil, nominal GDP and Brazil/US exchange rate given by IMF series *q.22399b.zf...h* and *q.223.rf.zf...h*.

df : Can/US federal government deficits as a percentage of nominal GDP.

Canadian and US federal government deficits from Statistics Canada series *v498381* and US Department of Commerce, Bureau of Economic Analysis series *defgf@gi*.

db: ratio of Canadian to US government debt as a percentage of nominal GDP.

Canadian total government debt calculated as sum of Statistics Canada series *v34422*, *v34460*, and *v34584*. US federal government debt from US Congressional Budget Office.

Appendix 2

CPE has the following specification: $\Delta(e-p)_t = \phi((e-p)_{t-1} - \Pi X_{t-1}) + \Gamma \Delta Z_{t-1} + \varepsilon$,

where $X = [k, com, ene]$ and $Z = [i, db]$;

e: logarithm of the nominal Canada-US exchange rate (Can$/US$);
p: logarithm of the ratio of Canada/US GDP deflators;
com: logarithm of the real non-energy commodity prices;
ene: logarithm of real energy commodity prices;
i: $\ln(1+i_c)/(1+i_u)]$;
i_c (i_u): Canadian (US) three-month commercial paper rate expressed as a quarterly rate;
db: logarithm of the ratio of Canadian to US public sector debt/nominal GDP.

The real exchange rate is a function of real commodity prices in the long run. Commodity exports are a major component of Canada's international trade, and their price movements tend to dominate variations in Canada's terms of trade. Short-run dynamics are captured by interest rate differentials and changes in relative government debt positions. The change in relative public sector debt positions (as a proportion of GDP) is also included. From a demand perspective, while additional government expenditure might lead to an appreciation in the short run, growing foreign indebtedness of the public sector would require a real depreciation over time to compensate for the growing debt servicing outflow in the current account.

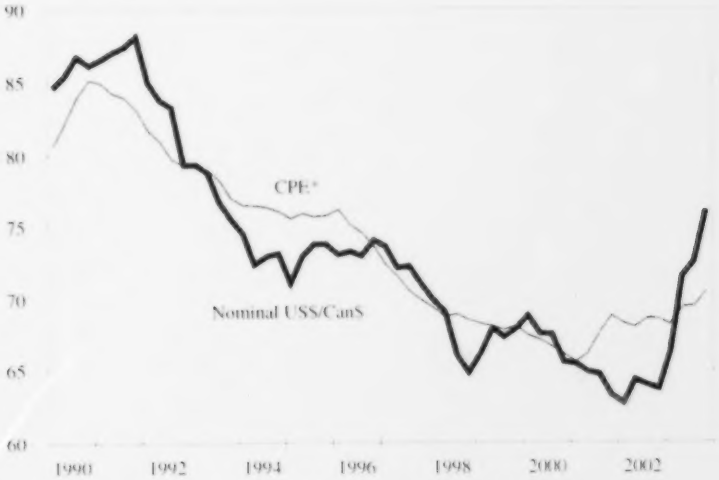
The coefficients of the non-energy commodity prices, interest rate differentials, and changes in relative public debt ratios are all significant and of the correct sign. In addition, corrected for degrees of freedom, CPE explains 25 per cent of the variance of the real exchange rate. However, real energy prices are not significant, and the presence of serial correlation of the residuals (Durbin-Watson statistic of 1.45) suggests that the specification could be improved. Moreover, the equation cannot account for the appreciation of the Canadian dollar in 2003. According to the equation, the appreciation was unwarranted (by its fundamentals) and could be reversed in the near term (Figure A2.1).

Table A2.1
CPE—coefficient estimates, 1975–99[a]

Variables	$(e-p)_{t-1}$	k_{t-1}	com_{t-1}	ene_{t-1}	i_{t-1}	Δdb_{t-1}
Coefficients	–0.15	0.33	–0.42	0.03 [0.36]	–2.80	0.34

a. *P*-values greater than 0.01 are reported in square brackets.

Figure A2.1
Actual vs. dynamic simulation (US cents)



* Estimated over 1975–99 period. Simulation begins in 1975.

Appendix 3

Tables and Figures

Table A3.1
Testing for unit roots and stationarity[a] (1975Q1 to 2003Q4)

	With trend		No trend	
Variables	**DF-GLS**	**MZ_t**	**DF-GLS**	**MZ_t**
e	−1.43	−1.68	−1.26	−1.33
com	−1.93	−2.01	−0.35	0.33
pmg	−2.81	−2.48	−0.31	−0.54
i	−2.32	−2.18	**−2.23**	**−2.01**
usd	−1.36	−1.29	−1.31	−1.28
p	−0.99	−0.75	−0.27	−0.01
xus	−2.77	−2.60	−1.70	−1.66

a. We report only test results for the variables that were retained in NEMO (results for all other variables are available upon request). Numbers in bold represent significance at the 5 per cent critical level. Refer to original papers for information on critical values. DF-GLS and MZ_t refer to the modified ADF and PP tests, respectively. Lag length was chosen using the modified Schwarz information criteria from Ng and Perron (2001).

Table A3.2
Tests for cointegration (1975Q1 to 2003Q4)

Engle-Granger test with null hypothesis of no cointegration[a]

No. of lags	ADF statistic	5% critical value	10% critical value
4	−3.13	−3.74	−3.45

Boswijk test with null hypothesis of no cointegration

No. of lags	Wald statistic	5% critical value	1% critical value
1	18.31	14.38	18.68

Johansen and Juselius test[b]

No. of cointegrating vectors under the null hypothesis	Trace statistic	5% critical value	1% critical value
Less than 1	56.40	47.86	54.68
Less than 2	26.08	29.80	35.46
Less than 3	10.78	15.49	19.94
Less than 4	2.88	3.84	6.63

No. of cointegrating vectors under the null hypothesis	λ^{max} statistic	5% critical value	1% critical value
Less than 1	30.40	27.58	32.72
Less than 2	15.22	21.13	25.86
Less than 3	7.90	14.26	18.52
Less than 4	2.88	3.84	6.63

a. Uses the data-dependent lag-selection procedure advocated by Campbell and Perron (1991). Critical values are from MacKinnon (1991).

b. The information criteria selected one lag as the optimal lag structure. The system is estimated with a constant in the cointegration space and an assumed linear trend only in the data. The results are not sensitive to this specification (details available upon request). Critical values are based on MacKinnon-Haug-Michelis (1999).

Table A3.3
Nominal exchange rate equations for the Canadian dollar[a]

Variables	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Long-run						
e_{t-1}	−0.13	−0.13	−0.13	−0.10	−0.10	−0.14
p_{t-1}	1	1	1	1	1	1
k	0.32	0.31	0.30	0.34	0.35	0.31
pmg_{t-1}	1.58[b]	1.75[b]	1.19[c]	1.60 [0.07][d]	0.50 [0.36][e]	1.51[f]; −1.15 [0.13]
com_{t-1}	−0.56	−0.57	−0.63	−0.51	−0.42	−0.59
Short-run						
i_{t-1}	−2.22	−2.26	−2.27	−1.96	−1.97	−2.26
Δusd_t	0.11	0.10 [0.01]	0.11	0.11	0.10 [0.02]	0.11
Δgdp_t	0	−0.38 [0.04]	0	0	0	0
Statistics						
$\bar{R}^2$	0.34	0.36	0.32	0.21	0.18	0.33
DW	1.70	1.74	1.62	1.33	1.28	1.69
RMSE(I)	0.027	0.027	0.036	0.055	0.056	0.029
RMSE(O)	0.060	0.068	0.050	0.054	0.069	0.058

a. Sample is 1975Q1 to 1999Q4. Only p-values greater than 0.01 are reported in square brackets. $\bar{R}^2$ is the adjusted $\bar{R}^2$ statistic; DW: Durbin-Watson statistic; root-mean-squared errors in [RMSE(I)] and out-of-sample [RMSE(O)] from dynamic simulations.
b. *pmg* refers to the ratio of manufacturing labour productivity to GDP per employee for Canada/US.
c. *pmg* refers to Canada/US labour productivity in manufacturing only.
d. *pmg* refers to Canada/US GDP per employee.
e. *pmg* refers to Canada/US GDP per capita.
f. *pmg* split into manufacturing and aggregate labour productivity, respectively.

Table A3.4
Nominal exchange rate equations[a]

Variables	EQ7	EQ8	EQ9	EQ10	EQ11	EQ12	EQ13
Long-run					NEMO		
e_{t-1}	−0.14	−0.14	−0.14	−0.14	−0.13	−0.14	−0.16
p_{t-1}	1	1	1	1	1	1	1
k	0.31	0.31	0.31	0.32	0.31	0.31	0.32
pmg^{b}_{t-1}	1.62	1.57	1.67	1.58	1.57	1.63	1.35
com_{t-1}	−0.53	−0.56	−0.54	−0.56	−0.54	−0.54	−0.49
Short-run 1							
i_{t-1}	−2.32	−2.21	−2.42	−2.27	−2.15	−2.27	−2.73
Δuid_t	0.09 [0.01]	0.11	0.09 [0.01]	0.11 [0.01]	0.11	0.10	0
Short-run 2							
Δuca_t	−0.19 [0.58]	−0.12 [0.75]	0	0	0	0	0
Δom_t	−0.05 [0.07]	0	−0.08 [0.01]	0	0	−0.05 [0.10]	0
Δff_t	−0.11 [0.37]	0	0	−0.11 [0.41]	0	0	0
Δuus_t	0.42	0	0	0	0.47	0.43	0
Statistics							
$\bar{R}^2$	0.45	0.33	0.37	0.34	0.45	0.46	0.29
DW	1.75	1.70	1.74	1.75	1.69	1.73	1.78
RMSE(D)	0.023	0.027	0.026	0.026	0.025	0.024	0.029
RMSE(O)	0.075	0.061	0.081	0.060	0.055	0.071	0.070

a. Statistics as in Table A3.3.
b. Ratio of manufacturing labour productivity to GDP per employee for Canada/US.

Table A3.5
NEMO parameter estimates for various samples[a]

Variables	75Q1–89Q4	75Q1–92Q3	75Q1–95Q1	75Q1–97Q3	75Q1–00Q1	75Q1–03Q4
Long-run						
e_{t-1}	−0.19	−0.14	−0.15	−0.15	−0.14	−0.11
p_{t-1}	1	1	1	1	1	1
k	0.30	0.28	0.29	0.29	0.31	0.32
pmg_{t-1}	1.44	1.79	1.70	1.69	1.54	1.89
com_{t-1}	−0.52	−0.52	−0.52	−0.52	−0.53	−0.62
Short-run						
s_{t-1}	−2.50	−1.97	−2.03	−1.96	−2.13	−1.83
Δuvd_t	0.10 [0.01]	0.10 [0.01]	0.11	0.12	0.11	0.16
Δvix_t	n/a[b]	n/a	0.35	0.33	0.48	0.53
Statistics						
$\bar{R}^2$	0.44	0.40	0.47	0.47	0.45	0.52
DW	1.59	1.65	1.77	1.79	1.68	1.69
NOBS[c]	60	70	80	90	100	116

a. Statistics as in Table A3.3.
b. Data start in 1994.
c. Number of observations in the estimation.

Table A3.6
Forecast comparison: NEMO vs. random walk with drift[a]

Horizon (quarters)	NEMO MAE	RWD MAE	NEMO RMSE	RWD RMSE	THEIL[b]
1	1.80	2.43	2.33	3.40	0.69
4	3.81	5.86	4.92	8.35	0.59
8	4.70	6.93	6.00	9.72	0.62
16	5.29	7.32	7.17	9.18	0.78

a. Except for THEIL, all numbers shown are multiplied by 100.
b. THEIL is the ratio of NEMO's RMSE to the RMSE of a RWD. A value less (greater) than one implies that NEMO performs better (worse) than a random walk with drift.

Table A3.7
Lagrange multiplier test for Kth order serial correlation[a]

Order	Test statistic[b]	
1	2.65	[0.10]
2	3.67	[0.16]
3	4.01	[0.26]
4	8.85	[0.07]
5	8.29	[0.14]
6	11.29	[0.08]
7	10.99	[0.14]
8	11.14	[0.19]

a. Breusch (1978)-Godfrey (1978) test with null hypothesis of no serial correlation.
b. Test statistic asymptotically follows the χ^2 distribution. *P*-values are reported in square brackets.

Table A3.8
Test for heteroscedasticity[a]

Test statistics[b]	5% critical value
21.47	23.69

a. White (1980) test with the null hypothesis of homoscedasticity.
b. Test statistic asymptotically follows the χ^2 distribution.

Table A3.9
Correlation coefficient test: Real non-energy commodity prices vs. US nominal effective exchange rate (excluding Canada)[a]

Lags/leads	Test statistic[b]
–4	–0.277
–3	0.063
–2	0.479
–1	0.832
0	–0.316
1	0.062
2	0.410
3	0.775
4	1.047

a. Testing the null hypothesis that the correlation coefficient is zero.
b. Test statistic asymptotically follows the *t* distribution. The 95 per cent critical value with 100 degrees of freedom is 1.98.

Figure A3.1

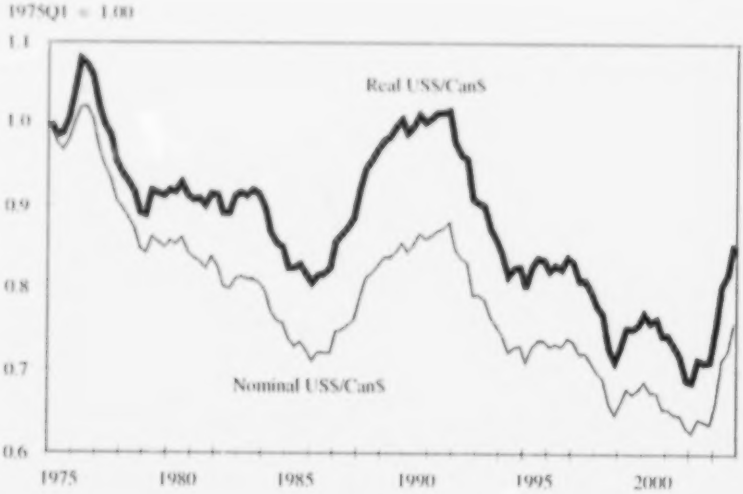


Figure A3.2

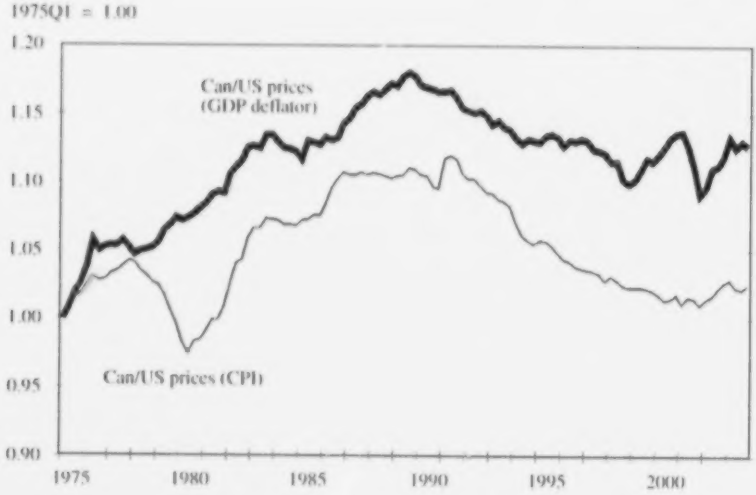


Figure A3.3

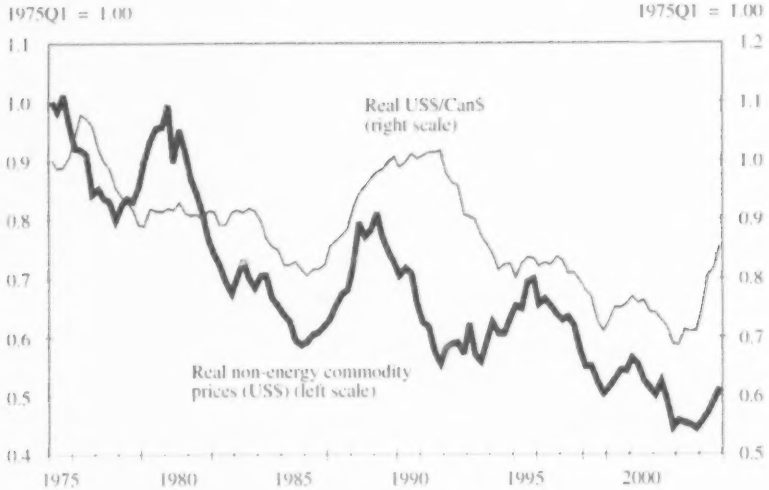
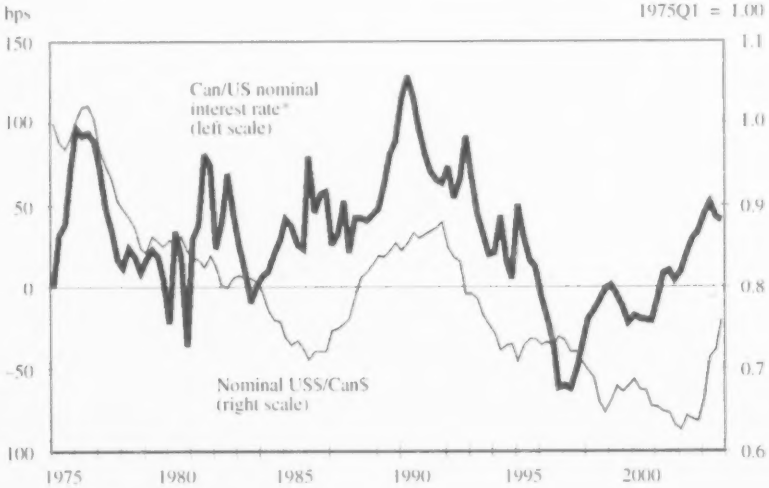


Figure A3.4



*ln[(1 + *i_can*)/(1 + *i_us*)]

Figure A3.5

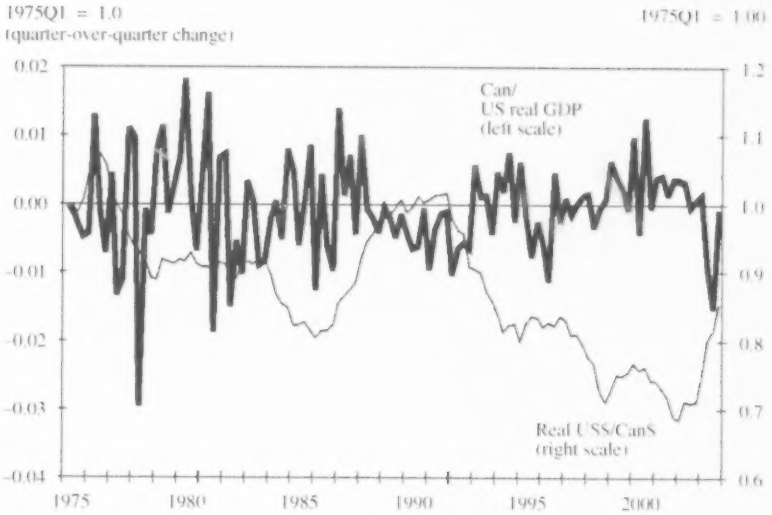


Figure A3.6

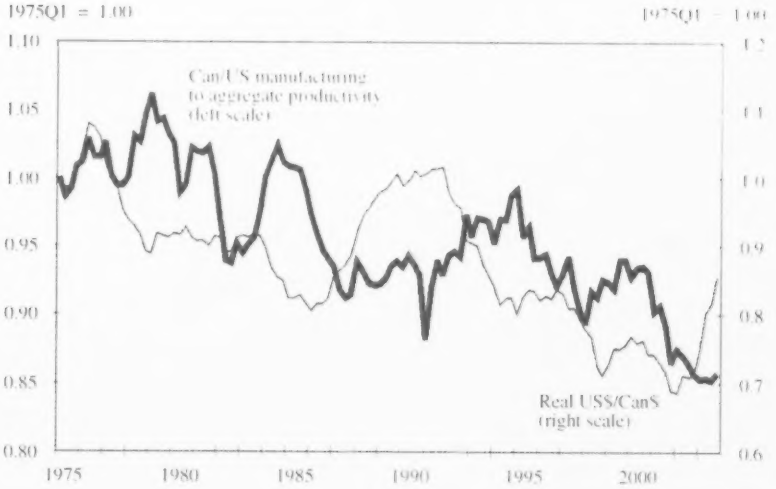


Figure A3.7

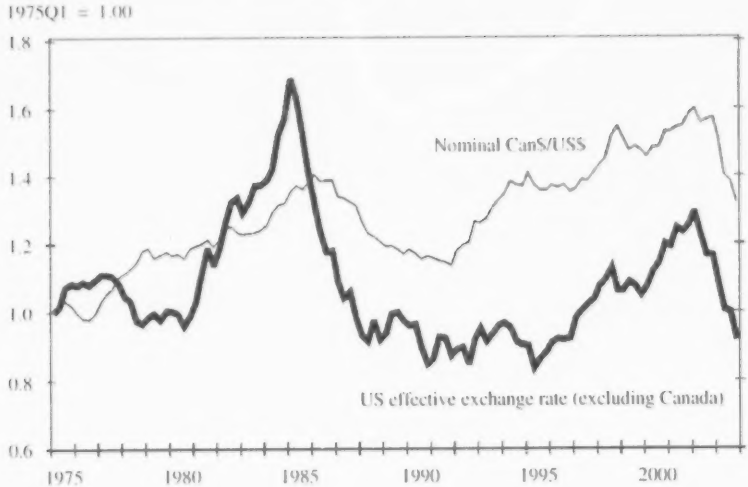


Figure A3.8

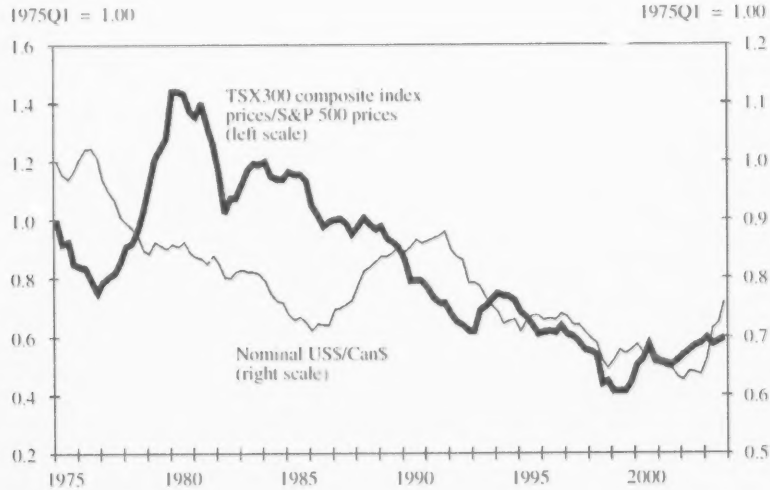


Figure A3.9

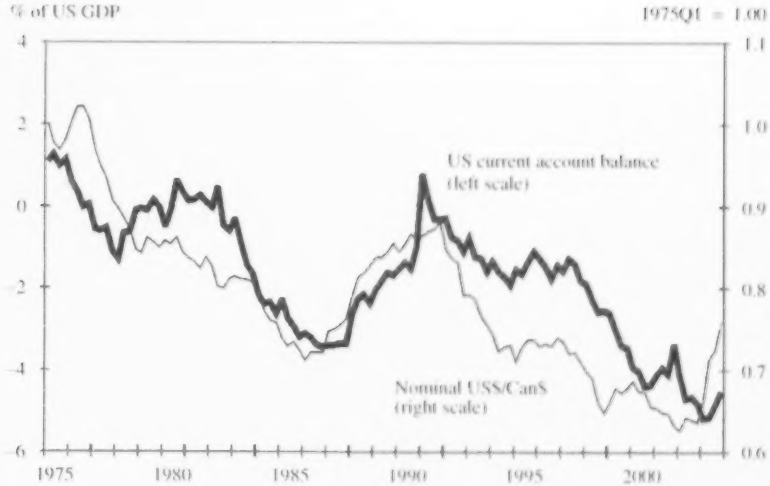
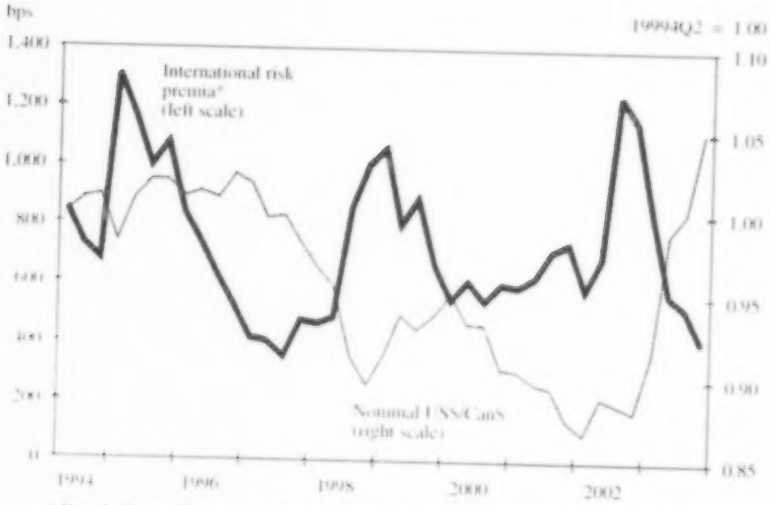


Figure A3.10

Figure A3.11



*Based only on Mexico and Brazil high-yield spread using average relative GDP weights.

Figure A3.12
Proportional change (%): Actual vs. dynamic simulation: Sample ending 2002Q4

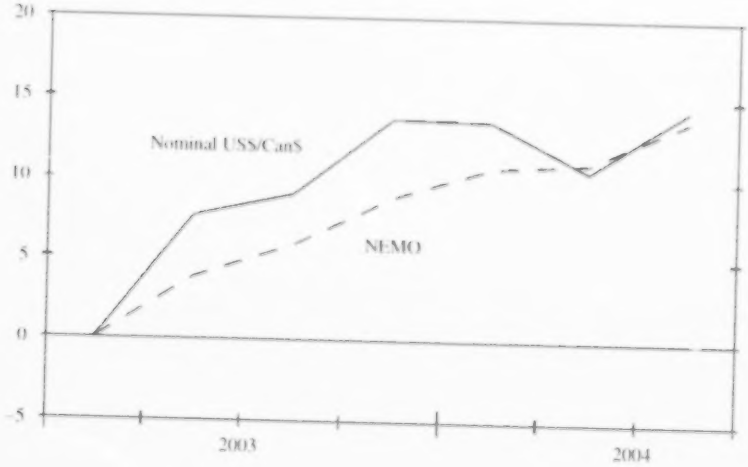


Figure A3.13
Proportional change (%): Long-run variables

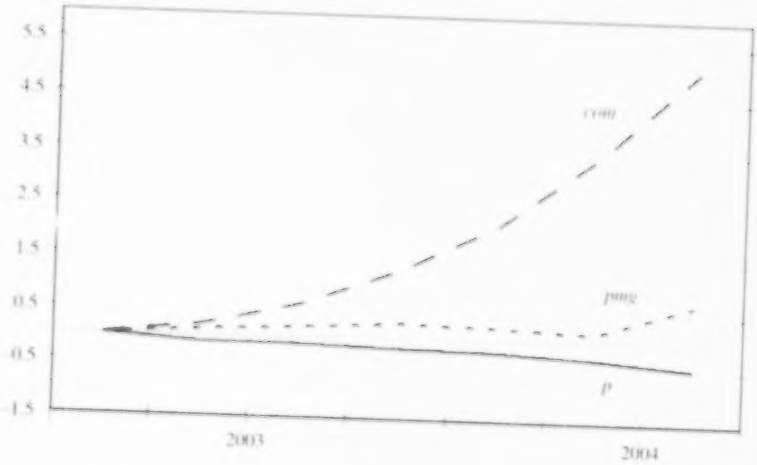


Figure A3.14
Proportional change (%): Short-run variables

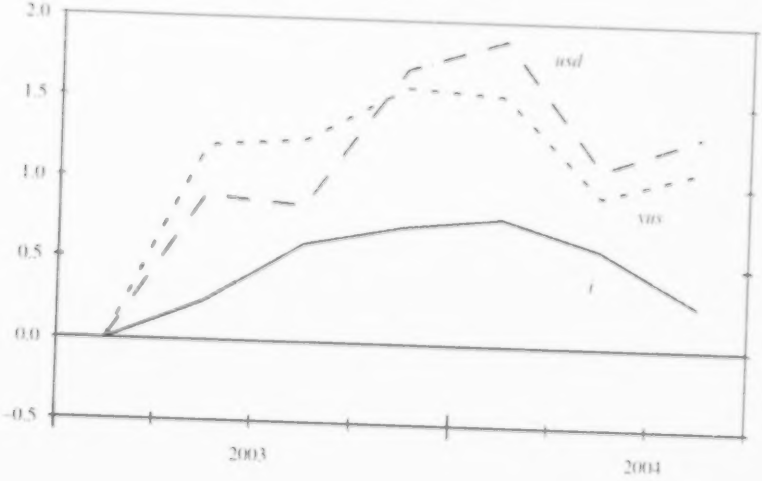


Figure A3.15
Proportional change (%): Long-run variables, 1975Q1 to 2004Q3

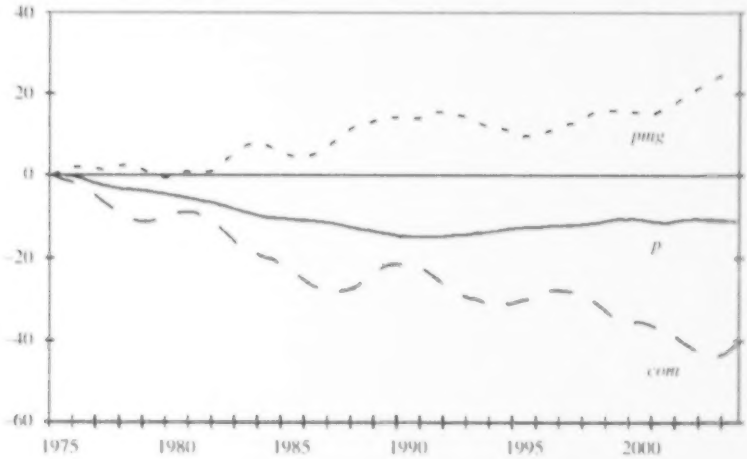


Figure A3.16
Proportional change (%): Short-run variables, 1975Q1 to 2004Q3

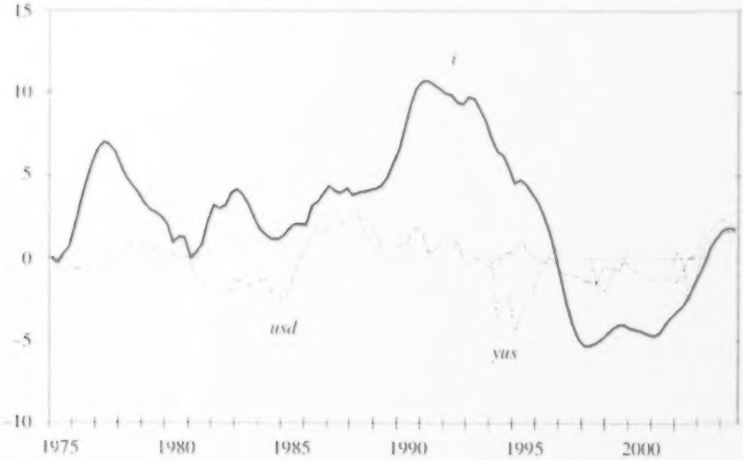


Figure A3.17
Parameter constancy: *e*

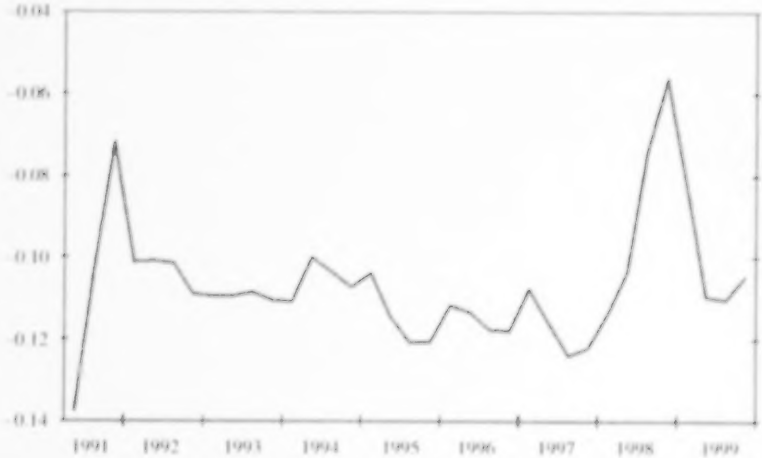


Figure A3.18
Parameter constancy: *k*

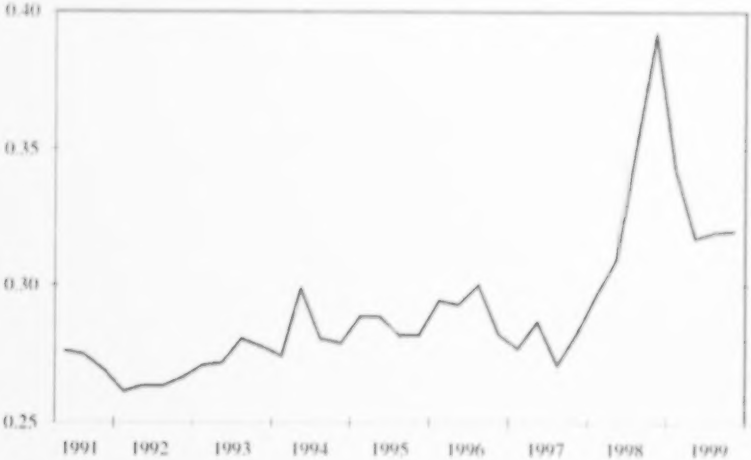


Figure A3.19
Parameter constancy: *pmg*

Figure A3.20
Parameter constancy: *com*

Figure A3.21
Parameter constancy: *i*

Figure A3.22
Parameter constancy: *usd*

Figure A3.23
Actual vs. dynamic simulation (US cents)

* Estimated over 1975–96 period. Simulation begins in 1975.

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Discussion

Rebecca Driver

Introduction

Ever since Meese and Rogoff (1983), finding a model that can systematically out-predict a random walk (or forecast of no change) has been a major goal in exchange rate economics. NEMO (or nominal exchange rate model) is of that genre. This single-equation model of the nominal exchange rate was constructed to track movements in the Can$/US$ exchange rate. Its intention is empirical rather than theoretical. The authors conduct a careful specification search to identify NEMO and, once they have done so, demonstrate that it can out-forecast a random walk with drift at the 1-, 4-, 8-, and 16-quarter horizons.

In my discussion, I will address four issues. First, I would like to explore why an ability to forecast exchange rates might be useful, particularly in a central bank context. I will touch on how NEMO compares with similar exchange rate models and raise two questions about its forecast abilities. Finally, even if NEMO provides the best empirical explanation for past movements in exchange rates, I ask whether there is anything that NEMO might miss that a central bank needs to worry about.

Why Model Short-Run Exchange Rate Movements?

Why would anyone want to forecast the exchange rate? Well, from a central bank perspective, changes to the exchange rate can have a significant impact on the forecast for inflation, and understanding how exchange rates are likely to evolve can be important. Nickell (2002), for example, cites unexpected movements in the exchange rate as significant in explaining the undershoot in UK inflation over the period 1999Q2 to 2001Q1.

Examples of the importance of the assumed exchange rate path for the inflation forecast, at least in the UK context, can be found in the *Inflation Reports*, published by the Bank of England. For example, the May 2000 *Inflation Report* provides an indication of how the forecast for RPIX (the retail price index excluding mortgage interest payments) inflation in the United Kingdom would have changed if the exchange rate profile had been based on either uncovered interest parity (UIP) or a random walk, instead of on the average of the two.[1] The May 2000 forecast for RPIX inflation would have been 0.1 percentage points higher than the central projection at the one-year horizon, and 0.2 percentage points higher at the two-year horizon if pure UIP had been assumed.[2] Clearly, the sensitivity of the inflation profile depends on the expected evolution of interest rates at home and abroad and hence the implied UIP path. However, improving our ability to forecast exchange rates could yield important improvements in our ability to forecast inflation and might help us understand the risks associated with forecasting exchange rates using either UIP or a random walk.

How Does NEMO Compare?

NEMO fits in, albeit not exactly, with a class that aims to model short-run equilibrium movements in exchange rates. Examples of such models include BEERs (behavioural equilibrium exchange rates), CHEERs (capital enhanced equilibrium exchange rates), and ITMEERs (intermediate term model-based equilibrium exchange rates).[3] In other words, NEMO is an exchange rate model informed by theoretical considerations, but whose form largely reflects empirical relationships.

Of the three models, the BEER is probably the most general and most popular.[4] How, then, does NEMO compare with the BEER framework? The BEER framework is based around UIP, with the assumption that the

1. Since November 1999, the Bank of England has used an average of a random walk and UIP as the exchange rate forecast underlying its *Inflation Report* projections. See the box on "The exchange rate in forecasting and policy analysis" from the November 1999 *Inflation Report*, published by the Bank of England.

2. Symmetry implies that the projection for RPIX inflation constructed using a pure random-walk model would have been 0.1 percentage points lower than the central projection at the one-year horizon and 0.2 percentage points lower at the two-year horizon. See Table 6.B on page 62 of the May 2000 *Inflation Report*, published by the Bank of England.

3. See Driver and Westaway (2005) for a review of short-, medium-, and long-run equilibrium exchange rate models.

4. See Alberola et al. (1999); Clark and MacDonald (2004); Maeso-Fernandez, Osbat, and Schnatz (2001); and MacDonald (2002) for examples of BEERs, as well as the discussion in Driver and Westaway (2005).

equilibrium level of the real exchange rate may move and there may also be a risk premium associated with UIP.[5] Therefore, in addition to interest rate differentials, exchange rates are explained using variables that are likely to drive either long-run equilibrium exchange rates or the risk premium. Clearly, given the coefficient on the interest rate differential, NEMO is not predicated on the assumption that UIP holds. However, some of the variables that have been used within the BEER framework might also be relevant for NEMO. Such variables include the relative price of traded versus non-traded goods, relative net foreign assets as a percentage of GDP, and relative government debt. It would be interesting to see if similar variables have something to add to NEMO.

The first of these variables, the relative price of traded versus non-traded goods, might be particularly interesting, since it could potentially capture Balassa-Samuelson effects. This variable is more likely to do so than relative productivity at home and abroad (either whole economy or manufactured sector), since the relative performance of the traded and non-traded sectors is the key to Balassa-Samuelson effects. It is therefore probably not surprising that the relative productivity variable in NEMO has the opposite sign to the one predicted by Balassa-Samuelson. The authors stress alternative justifications in their discussion of this variable, and I found them quite convincing. Indeed, my prior would have been that an increase in productivity at home relative to abroad would have necessitated an exchange rate depreciation (which is what they find) because, as the underlying balance models stress, an increase in supply without any change in demand will require a decrease in the price of domestic goods relative to foreign goods in order to re-equilibriate demand and supply.[6]

Losing NEMO

One of the big worries about attempting to model short-run exchange rate movements is that the relationships that underpin these models, which are often based more on empirical rather than theoretical relationships, might disappear. Therefore, it is important to ask the question, "Should we worry about losing NEMO?" On this front, I would raise two concerns, both of which could affect NEMO's forecast performance.

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5. The other key difference between the BEER framework and NEMO, therefore, is that the exchange rate variable typically used in the BEER framework is a real, rather than a nominal, exchange rate.

6. See Driver and Westaway (2005) for a discussion of this point and of underlying balance models.

My first concern is the presence of international high-yield bond spreads in the final specification for NEMO. These data are only available from 1994, and their inclusion reflects the fact that NEMO's specification was determined using a sample period ending in 1999Q4. However, the forecast comparisons between NEMO and a random walk, which are contained in the authors' Table 6, are conducted over the period 1994Q4 to 2003Q4. A true out-of-sample forecast test would have decided what form NEMO should take using data only up until 1994Q4, and my guess is that international high-yield bond spreads would not have been included in that specification. It would therefore be interesting to see the same forecast comparison exercise conducted over the period from 1999Q4 to the present.

Table 5 in the paper shows evidence on the variability of the estimated parameters in NEMO over different sample periods. The results indicate that the coefficient on international high-yield bond spreads displays the greatest variation between the largest and smallest estimates.[7] This is not unexpected, given the paucity of observations for the shorter sample periods. For this reason, it will be important to monitor the importance of international high-yield bond spreads in NEMO's performance going forward. It would also be interesting to see whether an equation of the same form as NEMO, but excluding international high-yield bond spreads, could also outforecast a random walk.

Another potential concern about NEMO's specification is the inclusion of the change in the US nominal effective exchange rate (excluding Canada) in the short-run dynamics of NEMO. Specifically, what happens if the main trends in the Can$/US$ exchange rate simply reflect trends in the US dollar more generally, or in other words, are exchange rate movements purely a US story? This might be important since, over the sample period used to estimate NEMO, the direction of change in the Can$/US$ and US-dollar exchange rate (excluding Canada) has been the same in over 60 per cent of occasions at the 1-quarter horizon. To investigate this, I ran a very simple test that compared the forecast performance over the four horizons (1, 4, 8, and 16 quarters) of two simple models. The first model is simply a pure random walk (RW). The second model (Dollar) forecasts movements in the Can$/US$ exchange rate by adjusting the current period's exchange rate by the actual change in the US effective exchange rate (excluding Canada) over the relevant horizon. The results from this experiment can be seen in Table 1, which compares the results from three sample periods.

7. This is true if the four sample periods that include estimates of the coefficient on international high-yield bond spreads are used, or if all six sample periods are included.

Table 1
Root-mean-squared errors comparison for two simple models

	Whole sample		Forecasts from 1994Q4		Forecasts from 1999Q4	
Horizon	**RW**	**Dollar**	**RW**	**Dollar**	**RW**	**Dollar**
1	2.51 (119)	4.64 (119)	3.36 (36)	4.35 (36)	4.09 (16)	3.95 (16)
4	6.49 (116)	11.30 (116)	8.15 (33)	9.00 (33)	10.86 (13)	9.89 (13)
8	9.75 (112)	17.28 (112)	10.08 (29)	13.94 (29)	13.47 (9)	13.06 (9)
16	14.56 (104)	23.89 (104)	12.68 (21)	14.92 (21)	15.66 (1)	2.72 (1)

Note: All numbers are multiplied by 100. Number of observations in parentheses.

The results suggest that movements in the Can$/US$ exchange rate have not simply reflected a US-dollar story since, except over the most recent sample period (from 1999Q4), the root-mean-squared errors associated with the random-walk model are smaller than those associated with the dollar model at all horizons.

Regardless of whether or not including the US nominal effective exchange rate (excluding Canada) leads to a biased impression of NEMO's success as a forecasting tool in traditional out-of-sample tests, there is another potential problem with including it; namely, in a real forecast situation, actual observations on movements in the US nominal effective exchange rate (excluding Canada) will not be available. Therefore, unless it is possible to find a model that can outperform a random walk for this exchange rate, this will reduce NEMO's potential success rate. The structure of NEMO reflects differences in the US and Canadian economies. It is not, therefore, clear that it can be generalized to other US exchange rates. The academic criterion for judging exchange rate forecast models has always been: can we beat a random walk given actual outturns for our explanatory variables. This reflects the desire to give the models every possible advantage, so that they are not rejected simply because one cannot forecast the explanatory variables. From a central bank perspective, however, the criterion may need to be adjusted. In particular, we should perhaps think about how our ability to predict the explanatory variables will influence the success of the model. If an important part of our increased explanatory power comes from variables that we cannot predict, we may be no better off.

What Might NEMO Miss?

An empirical equation such as NEMO is one way to assess the risks to an inflation forecast stemming from the exchange rate. However, NEMO may not capture all of the risks associated with specific one-off events, since the coefficients will reflect the average interactions between variables rather

than shock-specific outturns. One such example would be the risks stemming from a correction in the US dollar. An alternative approach would be to use the type of model explored in Obstfeld and Rogoff (2004) to supplement NEMO and to ask the question: How does the structure of the Canadian economy differ from the rest of the United States' main trading partners and, therefore, how different will the Canadian experience be? Obstfeld and Rogoff identify relative movements in non-traded goods prices as particularly important for determining the size of the necessary dollar correction in a general-equilibrium setting. NEMO does not include variables that would capture the behaviour of non-traded goods and does not impose an economic structure that would allow Canada's role relative to the rest of the world in a dollar correction to be assessed. For these reasons, while NEMO's forecast performance is impressive, it might usefully be supplemented by an Obstfeld and Rogoff-style approach.

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General Discussion*

In response to Paul Masson's comments on neglecting Canada's fiscal and current account balances, Jeannine Bailliu noted that Canada's current account balance was found not to be significant. One of the models, of course, included the differential in fiscal balances. She also argued that since the United States was assumed to be the driving force in the threshold model, consideration of bilateral factors was secondary. In a rejoinder, Masson said that a multilateral approach did not obviate the need for bilateral comparisons of economic determinants.

Robert Lafrance responded to Rebecca Driver's comments by noting that NEMO was not meant to be a forecasting equation (work was under way to develop a variant of NEMO for this purpose), but rather a means to interpret current developments as one of many inputs to monetary policy decisions. To the extent that NEMO tracks the historical data well, it conveys the message that markets work and that the exchange rate reflects economic fundamentals—most of the time.

In the general discussion that followed, Charles Engel argued that forecastability (as in Meese and Rogoff 1983) should not be considered an important validation criterion for an exchange rate model. Exchange rates are forward looking. They reflect expectations and change in response to news—they can't be forecast. The fact that commodity prices and interest rates reflect expectations about the future might explain why they are useful in explaining movements in the Canadian dollar. Gregor Smith asked if the adjustment parameter in NEMO was stable over time in light of changes that

* Prepared by Robert Lafrance.

occurred in the conduct of monetary policy since 1975. Lafrance answered that it was.

Marcel Fratzscher found the non-linearities in the Bailliu, Dib, and Schembri (BDS) model quite interesting. He sought further detail on their rationale and how they improved the model's fit. Bailliu responded that more work will be done on testing the importance of twin deficits in multilateral adjustment. Steve Kamin wondered why the BDS model indicated a threshold effect for the US fiscal deficit and not for the current account. Presumably, both deficits mattered. He also noted that exchange rate equations are important model components for policy simulation purposes. Lafrance pointed out that neither NEMO nor the threshold models were part of the Bank's macroeconomic model. These single-equation models are devised to test and tell stories. Bailliu remarked that the threshold model tells a twin-deficit story. Hafedh Bouakez wanted to see confidence intervals around the dynamic simulations that were presented. Lafrance responded that confidence intervals would not be very informative for dynamic simulations, since they grow over time by definition. He also noted that the coefficient estimates of NEMO were quite tight. Bill White observed that the twin-deficit story in the threshold model was not sufficient. It assumed that one should worry only if a shortage of national savings (reflected in a large current account deficit) was due to fiscal profligacy. He assumed that the "Lawson doctrine" was passé. Of major concern in the current conjuncture was the lack of household savings in the United States. Bailliu agreed that if the US current account deficit was financing a consumption boom, then it was not sustainable.

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Session 3:
Current Account Dynamics

Terms of Trade and Current Account Fluctuations: Evidence from Canada

*Hafedh Bouakez and Takashi Kano**

Introduction

Since the seminal work of Sachs (1981), the intertemporal approach to the current account has become a popular tool to study the indebtedness of countries and the borrowing and lending behaviour in international financial markets. In a nutshell, the intertemporal approach explains current account fluctuations as being the result of optimal saving and investment behaviour of rational, forward-looking economic agents in an open economy.[1] One of its implications is well known as the present-value model (PVM) of the current account. In its simplest form, the PVM implies that the current account is determined by the discounted sum of expected future changes in the economy's cash flow (or net output).[2]

The standard PVM of the current account has been evaluated by many studies, using time-series data from different countries, over various sample periods, and at different frequencies.[3] The common result of these studies is that the standard PVM fails to explain postwar current account fluctuations

1. The small-open-economy, optimal-growth model of Hamada (1966) is an explicit precursor to the intertemporal approach to the current account. An excellent review of this approach can be found in Obstfeld and Rogoff (1995).

2. We will refer to this version of the present-value model as the standard PVM.

3. See, for example, Sheffrin and Woo (1990), Otto (1992), Ghosh (1995), and Bergin and Sheffrin (2000).

* This paper is a shorter version of Bouakez and Kano (2004) that focuses only on Canada. We thank Jeannine Bailliu, Robert Lafrance, Lawrence Schembri, and Gregor Smith for helpful comments and suggestions.

of typical small open economies in general and Canada in particular. Indeed, the current account series predicted by the standard PVM is often found to be too smooth compared with the actual Canadian current account, a result that was characterized by Ghosh (1995) as the "excess smoothness puzzle" of the current account.

Although they use different analytical frameworks, two recent papers by Bergin and Sheffrin (2000) and Nason and Rogers (2004) emphasize the importance of stochastic variations in relative prices as a potential explanation for current account fluctuations in Canada.[4] More precisely, Bergin and Sheffrin show that amending the standard intertemporal model of the current account to include variable interest rates and exchange rates improves its fit substantially. Nason and Rogers, on the other hand, show that, among the features that are suspected to be responsible for the rejection of the standard PVM, world real interest rate shocks bring the "canonical" small-open-economy, real-business-cycle model closest to the data.[5]

In this paper, we develop a small open economy model with tradable and non-tradable goods and a time-varying world real interest rate. Unlike Bergin and Sheffrin (2000), however, we distinguish between exportable and imported goods, thus introducing an additional relative price, i.e., the terms of trade. Terms-of-trade shocks are widely regarded as a major force driving business cycle fluctuations in small open economies such as Canada.[6] This view has become even more popular after the oil-price shock in the early 1970s. In Canada, movements in the terms of trade are found to explain much of real exchange rate variability in the post Bretton Woods period.[7] This suggests that allowing for terms-of-trade variations can be helpful in explaining the Canadian current account.

The effects of terms-of-trade movements on the current account were initially studied by Harberger (1950) and Laursen and Metzler (1950), who show, using a Keynesian model, that an exogenous rise (fall) in the terms of

4. On the other hand, İşcan (2003) and Gruber (2004) show that allowing for durability and habit formation in consumption improves the ability of the PVM to fit the Canadian current account series. Furthermore, Normandin (1999) shows that departing from the infinite-horizon assumption typically used in the literature and introducing government bonds as part of household financial wealth help the standard model explain current account movements in Canada.

5. No consensus has been reached in the literature regarding the importance of real interest rate variations for aggregate fluctuations in a small open economy. For example, Hercowitz (1986) and Blankenau, Kose, and Yi (2001) provide evidence that real interest rate variations matter for aggregate fluctuations, while Mendoza (1991) finds no significant role for the real interest rate.

6. See Mendoza (1995), among others.

7. See Amano and van Norden (1995).

trade of a small open economy leads to an improvement in its trade balance. The reason is obvious: an improvement in a country's terms of trade raises its current income, and given a marginal propensity to consume less than unity, current consumption increases less than current income, causing private saving to increase. This so-called Harberger-Laursen-Metzler (HLM) effect has subsequently been examined within deterministic intertemporal models by Sachs (1981), Obstfeld (1982), and Svensson and Razin (1983), among others. More recently, the HLM effect was recast within dynamic general-equilibrium models by Backus (1993) and Mendoza (1995), for example.

This paper derives an approximate closed-form solution for the present-value representation of the current account, which encompasses the HLM effect in addition to the usual consumption-smoothing motive and the effects of future changes in the interest rate and the exchange rate, highlighted in Bergin and Sheffrin (2000). Moreover, while Bergin and Sheffrin identify only the intertemporal substitution effect of expected future changes in the consumption-based world real interest rate, our PVM allows us to study not only the intertemporal substitution effect but also the income and wealth effects associated with a change in the world real interest rate, as well as its instantaneous effect on net foreign interest payments.[8]

The cross-equation restrictions implied by the extended PVM are tested using Canadian data. The results show that the model without terms of trade is strongly rejected by the data, although its prediction tracks the actual current account series much better than the standard PVM. Including the terms of trade, however, does not improve the fit, and the extended PVM is still strongly rejected at all conventional levels of significance. This suggests that terms-of-trade shocks are not important for the Canadian current account, which corroborates earlier results by Otto (2003), who finds little evidence for the HLM effect in Canada.

The rest of the paper is organized as follows. Section 1 describes the model and derives a testable closed-form solution for the current account. Section 2 explains the testing procedure, describes the data, and discusses the results. Section 3 describes a robustness analysis, and the final section concludes.

8. Obstfeld and Rogoff (1996, 30) explain in detail the effects of real interest rate changes on consumption within a simple two-period, open-economy model.

1 The Model

1.1 The environment

Consider a small open economy where a representative infinitely lived household consumes a mix of tradable and non-tradable goods. The consumption index is a Cobb-Douglas aggregator given by

$$C_t = \omega_1 (C_t^T)^{\varepsilon} (C_t^N)^{1-\varepsilon} \qquad 0 < \varepsilon < 1, \tag{1}$$

where C_t^T is consumption of the tradable good, C_t^N is consumption of the non-tradable good, ε is weight of the tradable good in the consumption basket, and $\omega_1 \equiv \varepsilon^{-\varepsilon}(1-\varepsilon)^{\varepsilon-1}$ is a positive parameter. The Cobb-Douglas-type aggregator (equation (1)) implies unit elasticity of intratemporal substitution between the two types of goods. The tradable good is used as a numeraire and its price is normalized to one. Denoting by Q_t the price of the non-tradable good, i.e., the real exchange rate, the demands for tradable and non-tradable goods are given by, respectively,

$$C_t^T = \varepsilon P_t^C C_t \tag{2}$$

and

$$Q_t C_t^N = (1-\varepsilon) P_t^C C_t, \tag{3}$$

where P_t^C is the consumption-based price index given by

$$P_t^C = Q_t^{1-\varepsilon}. \tag{4}$$

As in Obstfeld (1996) and Obstfeld and Rogoff (1996, 266), we assume that the tradable good is itself a Cobb-Douglas aggregator of domestic exportable goods and imported goods,

$$C_t^T = \omega_2 X_t^{\gamma} M_t^{1-\gamma} \qquad 0 < \gamma < 1, \tag{5}$$

where X_t is consumption of exportable goods, M_t is consumption of imported goods, γ is the weight of exportable goods in the traded-good basket, and ω_2 is a constant given by $\omega_2^{\ 1} = \gamma^{\gamma}(1-\gamma)^{1-\gamma}$. Denoting by P_t^X and P_t^M the prices of the exportable and imported goods, respectively, the demands for these goods are given by

$$P_t^X X_t = \gamma C_t^T \tag{6}$$

and

$$P_t^m M_t = (1-\gamma)C_t^T. \tag{7}$$

In addition, the following condition must hold:

$$1 = (P_t^x)^{\gamma}(P_t^m)^{1-\gamma}. \tag{8}$$

Notice that from this equation, the terms of trade, defined as the relative price of exports in terms of imports, can be expressed as a function of the price of the exportable good

$$P_t \equiv P_t^x / P_t^m = (P_t^x)^{1/(1-\gamma)}. \tag{9}$$

The only tradable assets in this economy are international bonds, which are indexed to the tradable consumption basket. International financial markets are perfect but incomplete.[9] That is, the representative household can borrow and lend freely at the world common real interest rate, r_t, to smooth consumption intertemporally, but cannot buy or sell state-contingent claims to diversify away idiosyncratic shocks. The assumption of a small open economy requires that this economy cannot affect the world real interest rate or the terms of trade.

At the beginning of each period, the representative household receives an endowment of exportable and non-tradable goods, denoted by NY_t^x and NY_t^n, respectively. It pays $(1+r_t)B_t$ on bonds purchased in period $t-1$, and allocates remaining net output to consumption and the purchase of new bonds. Therefore, the household's budget constraint expressed in terms of the tradable consumption basket is

$$\begin{aligned} B_{t+1} &= (1+r_t)B_t + P_t^x NY_t^x + Q_t NY_t^n - P_t^x X_t - P_t^m M_t - Q_t C_t^N \\ &= (1+r_t)B_t + P_t^x NY_t^x + Q_t NY_t^n - P_t^c C_t. \end{aligned} \tag{10}$$

The representative household has the following lifetime utility:

$$E_t \sum_{i=0}^{\infty} \beta^i \frac{C_{t+i}^{1-1/\sigma}}{1-1/\sigma} \quad 0<\beta<1, \quad \sigma>0. \tag{11}$$

9. See footnote 13.

where E_t, β, and σ are: the mathematical expectation operator conditional on the information available at time t, the subjective discount factor, and the elasticity of the intertemporal substitution, respectively. The problem of the representative household is to maximize the lifetime utility function (equation (11)) subject to the budget constraint (equation (10)) and to a non-Ponzi-game condition. The first-order conditions for this dynamic problem are the Euler equation

$$1 = \beta E_t(1 + r_t + 1)\left(\frac{P_t^c}{P_{t+1}^c}\right)\left(\frac{C_t}{C_{t+1}}\right)^{1/\sigma} \tag{12}$$

and the transversality condition for the bond holdings $\lim_{i \to \infty} E_t R_{t,i} B_{t+1+i} = 0$, where $R_{t,i}$ is the ex post market-discount factor at period t for period $t + i$ consumption, which is defined as

$$R_{t,i} \equiv \begin{cases} 1/\left(\Pi_{j=t+1}^{t+i}(1 + r_j)\right) & \text{if } i \geq 1 \\ 1 & \text{if } i = 0. \end{cases}$$

The Euler equation (12) implies that the relevant interest rate for smoothing consumption between periods t and $t + 1$ is the consumption-based world real interest rate $(1 + r_{t+1})(P_t^c / P_{t+1}^c)$. Other things being equal, an expected rise in the consumption-based price index in period $t + 1$ lowers the expected one-period gross rate of return of foregoing one unit of consumption at time t.

1.2 Derivation of a closed-form solution

In equilibrium, the condition $NY_t^{\prime\prime} = C_t^N$ must hold. Thus, the budget constraint (equation (10)) becomes

$$\begin{aligned} B_{t+1} &= (1 + r_t)B_t + P_t^{\prime} NY_t^{\prime} - P_t^{\prime} X_t - p_t^{\prime\prime\prime} M_t \\ &= (1 + r_t)B_t + P_t^{\prime} NY_t^{\prime} - C_t^I, \end{aligned} \tag{13}$$

where the second equality follows from the fact that $C_t^I = P_t^{\prime} X_t + P_t^{\prime\prime\prime} M_t$. Iterating equation (13) forward and using the transversality condition yields the ex ante intertemporal budget constraint

$$\sum_{i=0}^{\infty} E_t R_{t,i} C^I_{t+i} = (1 + r_t)B_t + \sum_{i=0}^{\infty} E_t R_{t,i} P^X_{t+i} NY^X_{t+i}.$$

Dividing both sides of this equation by $P^I_t Y_t$, and using the approximation $\ln(1 + r_t) = r_t$, yields, after some algebra (see Appendix 1 for details),

$$\varepsilon\tau_t\left[1 + \sum_{i=1}^{\infty} E_t \exp\left\{\sum_{j=t+1}^{t+i} (\Delta c^I_j - r_j)\right\}\right] = \exp(r_t)b_t$$

$$+ \eta_t\left[1 + \sum_{i=1}^{\infty} E_t \exp\left\{\sum_{j=t+1}^{t+i} (\Delta ny^X_j + \Delta p^X_j - r_j)\right\}\right],$$

where $\tau_t = C_t / Y_t$ is the consumption-output ratio, $\eta_t = P^X_t NY^X_t / P^I_t Y_t$ is the ratio of exportable net output to total output, $b_t = B_t / P^I_t Y_t$ is the ratio of international bonds to total output, $\Delta c^I_t = \ln C^I_t - \ln C^I_{t-1}$, $\Delta ny^X_t = \ln NY^X_t - \ln NY^X_{t-1}$, and $\Delta p^X_t = \ln P^X_t - \ln P^X_{t-1}$. It is assumed that τ_t, η_t, b_t, Δc^I_t, Δny^X_t, Δy_t, r_t, and Δp^X_t follow stationary processes with the unconditional means τ, η, b, g^c, g^{ny}, r, and g^p, respectively. The intertemporal budget constraint is then linearly approximated by taking a first-order Taylor expansion around the unconditional means. For any variable x_t, let $\tilde{x}_t$ denote the deviation from its unconditional mean. The linearly approximated intertemporal budget constraint then is (see Appendix 1 for details):

$$\varepsilon\tilde{\tau}_t - \frac{1-\alpha}{1-\kappa}\tilde{\eta}_t = (1-\alpha)\exp(r)\tilde{b}_t + (1-\alpha)\exp(r)b\tilde{r}_t$$

$$- \varepsilon\tau \sum_{i=1}^{\infty} \alpha^i E_t[\widetilde{\Delta c^I_{t+i}} - \tilde{r}_{t+i}]$$

$$+ \eta\frac{1-\alpha}{1-\kappa} \sum_{i=1}^{\infty} \kappa^i E_t[\widetilde{\Delta ny^X_{t+i}} + \widetilde{\Delta p^X_{t+i}} - \tilde{r}_{t+i}], \qquad (14)$$

where $\alpha = \exp(g^c - r)$ and $\kappa = \exp(g^{ny} - \mu + g^p)$ are assumed to be less than one.[10]

10. The conditions $\alpha < 1$ and $\kappa < 1$ are required to satisfy boundedness of the expected present discounted-value terms of equation (14).

To derive a log-linear approximation of the Euler equation for the consumption basket (equation (12)), we follow Campbell and Mankiw (1989); Campbell (1993); and Campbell, Lo, and MacKinlay (1997, 306) in assuming that the world real interest rate r_t, the consumption price index $P_t^c = Q_t^{1-\varepsilon}$, and the consumption basket C_t are jointly conditionally homoscedastic and log-normally distributed. In this case, the Euler equation (12) can be log-linearized as

$$E_t\widetilde{\Delta c_{t+1}} = \sigma E_t\tilde{r}_{t+1} - \sigma(1-\varepsilon)E_t\widetilde{\Delta q_{t+1}}, \tag{15}$$

where the unconditional mean of Δc_t is given by $E\Delta c_t = \sigma(\ln\beta + \delta - \mu) - \sigma(1-\varepsilon)g^q$.[11] From this equation and the demand function for the tradable consumption basket (equation (2)), it is easy to show that the Euler equation for the tradable consumption basket is approximated by

$$E_t\widetilde{\Delta c_{t+1}^T} = \sigma E_t\tilde{r}_{t+1} + (1-\sigma)(1-\varepsilon)(E_t\widetilde{\Delta q_{t+1}}), \tag{16}$$

where the unconditional mean of Δc_t^T is given by $E\Delta c_t^T = \sigma r + (1-\sigma)(1-\varepsilon)g^q$.

Finally, to derive an approximate solution for the current account-output ratio $ca_t \equiv (CA_t/P_t^y Y_t)$, we assume that the economy possesses a balanced growth path, where $\alpha = \kappa$. From the current account identity

$$CA_t \equiv r_t B_t + p_t^x NY_t^x - C_t^T \tag{17}$$

and equations (9), (14), and (16), we can obtain the following present-value representation of the current account-output ratio (see Appendix 2 for details):

$$\begin{aligned} \tilde{ca}_t = {} & b\tilde{r}_t + [\eta + \varepsilon\tau(\sigma-1)]\sum_{i=1}^{\infty}\kappa^i E_t\tilde{r}_{t+i} - \eta\sum_{i=1}^{\infty}\kappa^i E_t\widetilde{\Delta ny_{t+i}^x} \\ & + \varepsilon\tau(1-\sigma)(1-\varepsilon)\sum_{i=1}^{\infty}\kappa^i E_t\widetilde{\Delta q_{t+i}} - \eta(1-\gamma)\sum_{i=1}^{\infty}\kappa^i E_t\widetilde{\Delta p_{t+i}}. \end{aligned} \tag{18}$$

The first term in the RHS of equation (18), $b\tilde{r}_t$, shows the instantaneous effect of a change in the current world real interest rate on the current account. As can be seen from the current account identity (equation (17)),

11. δ is a constant term including the constant variances of r_t, $\Delta\ln C_t$, and $\Delta\ln Q_t$ and the constant covariances across them.

for example, if the economy is a net debtor (i.e., $B_t < 0$), a rise in r_t increases the net foreign interest payment instantaneously, and the current account moves into deficit. The second term, $[\eta + \varepsilon\tau(\sigma - 1)]\sum_{i=1}^{\infty}\kappa^i E_t \tilde{r}_{t+i}$, measures the impact of expected future changes in the world real interest rate on the current account. As discussed in Obstfeld and Rogoff (1996, chapter 2), this impact can be decomposed into substitution ($\varepsilon\tau\sigma$), income ($-\varepsilon\tau$), and wealth (η) effects. The traditional consumption-smoothing motive is captured by the third term, $-\eta\sum_{i=1}^{\infty}\kappa^i E_t \widetilde{\Delta ny^*_{t+i}}$: the household adjusts the current account to smooth consumption to an income shock.

The fourth term, $\varepsilon\tau(1-\sigma)(1-\varepsilon)\sum_{i=1}^{\infty}\kappa^i E_t \widetilde{\Delta q_{t+i}}$, reflects the effect of expected future changes in the real exchange rate on the current account, which can also be decomposed into *intertemporal* substitution ($-\varepsilon\tau\sigma(1-\varepsilon)$) and *intratemporal* substitution ($\varepsilon\tau(1-\varepsilon)$) effects (see Bergin and Sheffrin (2000) for further discussion).[12] The last term, $-\eta(1-\gamma)\sum_{i=1}^{\infty}\kappa^i E_t \widetilde{\Delta p_{t+i}}$, captures the effect of expected future changes in the terms of trade on the current account, or the HLM effect: given the expected future path of ny^*, an expected future rise in p increases the expected relative price of exportable goods in terms of the tradable basket (i.e., p_t^*) with elasticity $1-\gamma$, which, in turn, increases permanent income.[13] Hence, current consumption rises, while current income is unchanged. As a result, the current account moves into deficit.[14]

12. One advantage of the present-value representation derived in this paper is that it disentangles explicitly the effects of variable world real interest rate from the effects stemming from movements in the real exchange rate. In contrast, Bergin and Sheffrin (2000) embed these two effects in their model by constructing a measure of the consumption-based real interest rate. A possible drawback of this approach is that the series used in the estimation procedure depends on the structural parameters.

13. On the other hand, if a change in the terms of trade is expected to be permanent, the HLM effect disappears, because the household cannot smooth away a permanent shock, as the standard permanent income hypothesis predicts. See Svensson and Razin (1983) for the relationship between the HLM effect and the persistence of the terms-of-trade shocks.

14. Backus (1993) shows that under the assumption of complete markets, the relationship between the terms of trade and the trade balance is independent of the properties of terms-of-trade shocks. This is because market completeness means that there exists a complete set of state-contingent securities that enable the representative household to insure against all idiosyncratic risks, thereby implying that there is no permanent income effect arising from terms-of-trade shocks.

2 Econometric Analysis

2.1 Evaluating the PVM

To evaluate the PVM (equation (18)) empirically, we start by deriving the cross-equation restrictions that the PVM imposes on the unrestricted vector autoregression (VAR). Let X_t denote a 5×1 column vector defined as $X_t = [\tilde{r}_t \ \widetilde{\Delta nx_t^*} \ \widetilde{\Delta q_t} \ \widetilde{\Delta p_t} \ ca_t]'$. It is assumed that the probability distribution of X_t is well approximated by a pth order unrestricted VAR: $X_t = A^1 X_{t-1} + A^2 \ X_{t-2} + \ldots + A^p X_{t-p} + v_t$, where A^i is the ith coefficient matrix with an $(m, n)th$ typical element $a(m, n)^i$, and v_t is a 5×1 vector of unrestricted i.i.d. (identically, independently distributed) disturbances with variance-covariance matrix Ω.

Since any higher-order VAR has a first-order representation with a $5p \times 5p$ companion matrix A, we can rewrite the pth order VAR as $\chi_t = A\chi_{t-1} + v_t$, where $\chi_t = [X_t' X_{t-1}' \ldots X_{t-p-1}']'$ and $v_t = [v_t' 0 \ldots (0)]'$, respectively. Let e_i denote the $1 \times 5p$ row vector in which the ith element is 1, but the rest of elements are zeros. Then, the PVM (equation (18)) implies the following cross-equation restrictions:

$$e_5\chi_t = be_1\chi_t + \sum_{i=1}^{\infty} k^i\{[\eta + \varepsilon\tau(\sigma - 1)]e_1 - \eta e_2$$

$$+ \varepsilon\tau(1 - \sigma)(1 - \varepsilon)e_3 - \eta(1 - \gamma)e_4\}A^i\chi_t, \tag{19}$$

or, equivalently,

$$e_5 = be_1 + \{[\eta + \varepsilon\tau(\sigma - 1)]e_1 - \eta e_2 + \varepsilon\tau(1 - \sigma)(1 - \varepsilon)e_3$$

$$-\eta(1 - \gamma)e_4\}\kappa A[I_{5p} - \kappa A]^{-1} = F(\sigma, \gamma, \varepsilon, \kappa; b, A, \eta, \tau). \tag{20}$$

These cross-equation restrictions can be tested statistically using a Wald test. More precisely, let $\hat{e}_5$ denote the estimated value of e_5, $\partial\hat{e}_5/\partial A$ the matrix of derivatives of $\hat{e}_5$ with respect to the elements $a(m, n)^i$ and V the variance-covariance matrix of those elements. Then

$$(\hat{e}_5 - e_5)'W^{-1}(\hat{e}_5 - e_5) \sim \chi^2(5p),$$

where

$$W = \left(\frac{\partial\hat{e}_5}{\partial A}\right)' V\left(\frac{\partial\hat{e}_5}{\partial A}\right).$$

In addition, a predicted current account series, $\widehat{ca}_t$, can be constructed as

$$\widehat{ca}_t \equiv be_1\chi_t + \{[\eta + \varepsilon\tau(\sigma - 1)]e_1 - \eta e_2 + \varepsilon\tau(1 - \sigma)(1 - \varepsilon)e_3$$

$$-\eta(1 - \gamma)e_4\}\kappa A[I_{S_p} - \kappa A]^{-1}\chi_t \tag{21}$$

and compared with the actual series.

2.2 Data

The PVM is tested using quarterly Canadian data from 1962Q2 to 2001Q2. The data sources are Statistics Canada and International Financial Statistics. Following Barro and Sala-i-Martin (1990), the world real interest rate series is constructed as a GDP-weighted average of real interest rates in the G-7 countries. For each country, the real interest rate is computed as the three-month treasury bill rate, or an equivalent short-term rate, adjusted by expected CPI inflation. The latter is obtained from a sixth-order auto-regression, as suggested by the sequential likelihood ratio and Akaike information criteria. To construct the net exportable output series, we proceed as follows. We measure gross exportable output by subtracting from total real GDP the (real) value of output in the service industry. Since we do not have disaggregated data on GDP components, we compute the net exportable output by assuming that the share of output in the service industry that is used for investment and government spending purposes is equal to the share of aggregate investment and public spending in total output. The series of net exportable output is expressed in per capita terms using the civilian population, age 16 and over. Following Rogoff (1992) and Bergin and Sheffrin (2000), the real exchange rate is measured by the real effective exchange rate of the Canadian dollar, which is obtained by multiplying the nominal effective exchange rate by the Canadian consumer price index and dividing it by the consumption price index for the G-7 countries. The terms of trade are computed as the ratio of export to import prices (section 3 performs robustness analysis using an alternative measure of the terms of trade). In conformity with equation (18), the net exportable output, the real exchange rate, and the terms-of-trade series are logged and expressed in first differences. The current account series is constructed by adding the real trade balance and real foreign interest payments. The series is then divided by real output to obtain the current account-output ratio. Finally, all the series are demeaned.

The raw and transformed series are plotted in Figures 1 and 2, respectively.[15] The ratio of the current account to GDP is weakly correlated with all the transformed variables. In particular, the correlation between this series and changes in the terms of trade is less than 0.05, which is consistent with the value of 0.04 computed by Backus, Kehoe, and Kydland (1994), using Hodrick-Prescott-filtered terms-of-trade series.[16] Changes in the real exchange rate and the terms of trade are also weakly correlated (0.14), which implies that we could potentially identify the effects stemming from stochastic variations in these two relative prices.

Before testing the PVM (equation (18)), we need to check the stationarity of the series used in the unrestricted VAR. To do so, we conduct unit-root tests for the elements of the vector $X_t = [\tilde{r}_t \ \widetilde{\Delta nx}_t^1 \ \widetilde{\Delta q}_t \ \widetilde{\Delta p}_t \ \widetilde{ca}_t]'$, based on the augmented Dickey-Fuller (ADF) τ-statistics. With each element x_t of the vector X_t, we estimate the following ADF equation by ordinary least squares:

$$\Delta x_t = \rho x_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta x_{t-i} + \varepsilon_t, \tag{22}$$

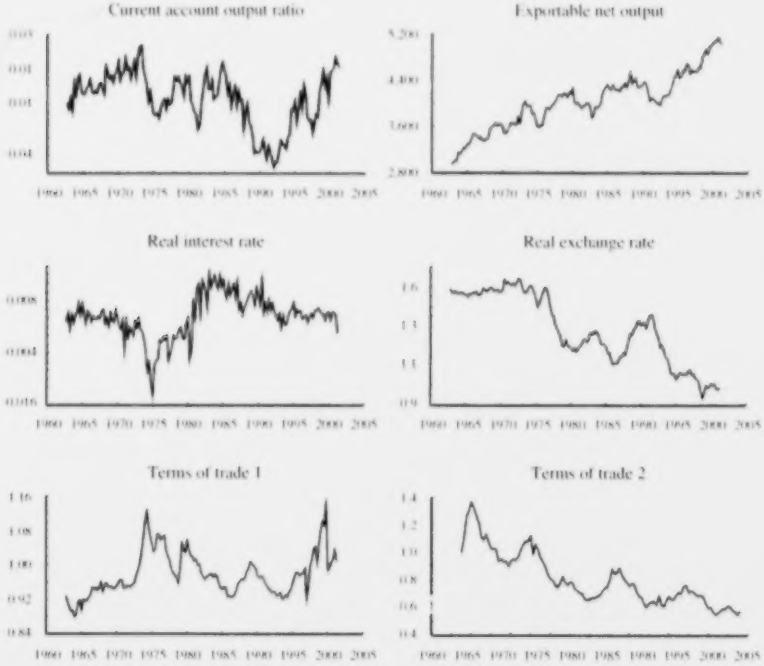
where we choose 1, 3, 5, and 7 as the optimal lag p. Because each element x_t is a demeaned series, we ignore the constant term in the above regression, following Bergin and Sheffrin (2000). The ADF τ-statistic is calculated as the standard t-statistic attached to the OLS estimate of ρ. Since the ADF τ-statistic is non-standard, Davidson and MacKinnon (1993) tabulate its asymptotic critical values under the null hypothesis of the unit root. In particular, the critical values for the unit-root null at the 10, 5, and 1 per cent significance levels are −1.62, −1.94, and −2.56, respectively.

Table 1 reports the results of the unit-root tests for the elements of the vector X_t. For three different lag specifications, the ADF τ-statistics reject the unit-root nulls for all the five elements at least at the 5 per cent significance level, except in two cases ($\tilde{r}_t$ with seven lags and $\widetilde{ca}_t$ with five lags). Thus, we conclude that the elements of the vector X_t are stationary.

15. The series labelled terms of trade 1 corresponds to the ratio of export to import prices. The series labelled terms of trade 2 is the one used to check the robustness of the results and will be discussed in section 3.

16. In fact, Backus, Kehoe, and Kydland find little covariance between the trade balance and the terms of trade in Canada, at any lead or lag.

Figure 1
Raw Canadian data



2.3 Results

The purpose of this paper is to determine whether a present-value model of the current account that allows for stochastic variations in the terms of trade improves upon earlier models in explaining current account movements. Thus, to gauge the matching performance of PVM (equation (18)), it is useful to compare its predictions with those generated by two "restricted" versions: the standard PVM, where there are no variations in the interest rate, the exchange rate, or the terms of trade, and a model that allows for time-varying real interest rates and real exchange rates but with constant terms of trade.[17]

17. The term "restricted" should not be interpreted in a statistical sense here, for two reasons. First, as will be explained further, by construction, the PVM model presented in this paper does not nest the standard PVM. Second, the VAR parameters used to compute the predicted current account series are based on a different information set for each model.

Figure 2
Transformed Canadian data

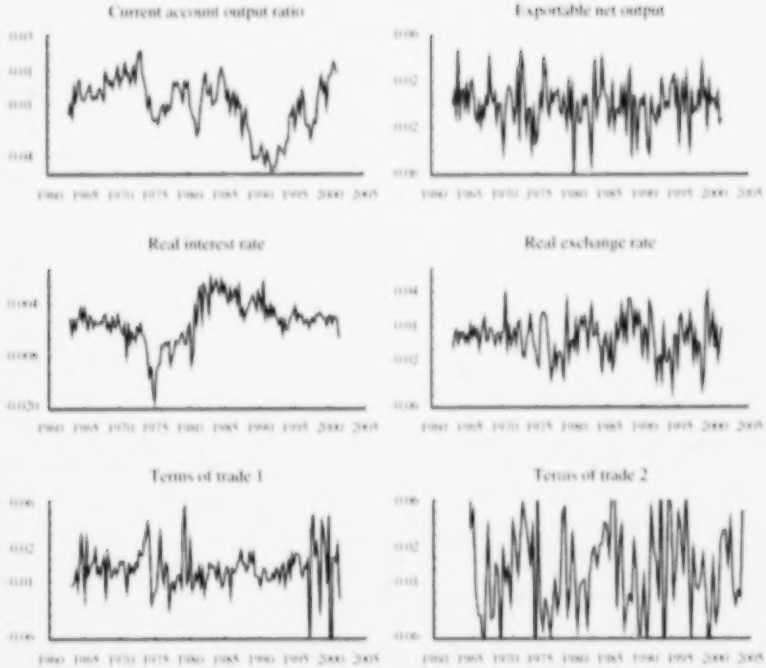


Table 1
Unit-root test results

	Lag length			
Variable	**1**	**3**	**5**	**7**
$\tilde{r}_t$	$-2.103^{\dagger}$	$-2.105^{\dagger}$	$-2.048^{\dagger}$	-1.805^{*}
$\widetilde{\Delta nx}_t$	$-8.206^{\ddagger}$	$-6.036^{\ddagger}$	$-5.125^{\ddagger}$	$-5.408^{\ddagger}$
$\widetilde{\Delta q}_t$	$-9.148^{\ddagger}$	$-5.234^{\ddagger}$	$-4.113^{\ddagger}$	$-3.248^{\ddagger}$
$\widetilde{\Delta p}_t$	$-7.109^{\ddagger}$	$-6.970^{\ddagger}$	$-4.782^{\ddagger}$	$-4.670^{\ddagger}$
$\widetilde{ca}_t$	$-2.103^{\dagger}$	$-2.273^{\dagger}$	-1.731^{*}	$-2.094^{\dagger}$

Note: The superscripts *, †, and ‡ denote rejections of the null hypothesis of a unit root at the 10, 5, and 1 per cent significance levels, respectively.

The standard PVM assumes that there are no variations in the real interest rate, the exchange rate, or the terms of trade. That is,

$$\tilde{ca}_t = -\eta \sum_{i=1}^{\infty} \kappa^i E_t \widetilde{\Delta ny}_{t+i},$$

where ny_t is the log of net output. Since this model assumes that all goods are tradable, the parameter η is calibrated to match the average ratio of net output to total output, which is estimated to be 0.489 for Canada, while the parameter κ is set to 0.99. Figure 3 depicts the actual current account series and that predicted by the standard PVM. In this case, the underlying unrestricted VAR is bivariate and includes the variables $\widetilde{\Delta ny}_t$ and $\tilde{ca}_t$ only.[18] Figure 3 shows that the predicted series is much smoother than the actual one. That is, the standard model fails to generate movements in the current account of the same magnitude as those observed in the data. This failure, however, is not reflected in the results of the statistical tests reported in Table 2. This table shows that the Wald statistic has a p-value of 0.0747, meaning that the cross-equation restrictions implied by the standard PVM can be rejected at the 10 per cent significance level, but not at the 5 per cent level. This is somewhat surprising, given that earlier studies, such as those by Sheffrin and Woo (1990), Ghosh (1995), Bergin and Sheffrin (2000), and Nason and Rogers (2004), report strong rejections of the standard PVM.[19]

The second model that will serve as a benchmark is a PVM with real interest rate and real exchange rate variations. That is,

$$\tilde{ca}_t = b\tilde{r}_t + [\eta + \varepsilon\tau(\sigma - 1)] \sum_{i=1}^{\infty} \kappa^i E_t \tilde{r}_{t+i} - \eta \sum_{i=1}^{\infty} \kappa^i E_t \widetilde{\Delta ny^*}_{t+i}$$

$$+ \varepsilon\tau(1 - \sigma)(1 - \varepsilon) \sum_{i=1}^{\infty} \kappa^i E_t \widetilde{\Delta q}_{t+i}.$$

Bergin and Sheffrin (2000) show that extending the standard PVM along those dimensions improves its fit dramatically. To evaluate this extended version of the PVM in our context, we need to assign values to the parameters σ, ε, κ, τ, η, and b. The parameters τ, η, and b can be

18. For the standard PVM, as well as for the two extended versions discussed below, the optimal lag length suggested by the Schwartz criterion is 1.

19. When contrasting our findings with those of earlier papers, one should bear in mind an important distinction: the standard PVM model tested in this paper involves the current account output ratio, rather than the *level* of the current account, as is typically done in the literature.

Table 2
Calibrated parameters

Parameter	Standard PVM	Extended PVM
τ	0.469	0.469
η	0.489	0.179
b	—	−0.269

Figure 3
Actual Canadian current account and the prediction of the standard PVM

estimated directly using data on the consumption-output ratio, the ratio of exportable net output to total output, and the ratio of international bonds to total output, respectively. The other parameters are more problematic, either because they are preference parameters or because we do not have reliable data to estimate them directly. Our strategy, therefore, is to estimate these parameters by minimizing the distance between the prediction of the PVM and the data. More precisely, we select the parameters that minimize the root-mean-squared error (RMSE) associated with the predicted current account series. This procedure yields a point estimate of the intertemporal elasticity of substitution, σ, of 0.008. This low value is consistent with Bergin and Sheffrin's estimate of 0.039.[20] The share of tradable goods in

20. Bergin and Sheffrin (2000) obtain this value by minimizing the Wald statistic.

total consumption, ε, is estimated to be 0.72. This estimate is higher than the value of 0.5 reported by Stockman and Tesar (1995), but it is too imprecise to allow reliable conclusions. Finally, the estimated discount factor, κ, is 0.999.

Figure 4 shows the current account series predicted by the PVM with time-varying interest and exchange rates. This series was generated using the point estimates of the structural parameters, and the estimated parameters of an unrestricted VAR that includes $\tilde{r}_t$, $\widetilde{\Delta ny_t^s}$, $\widetilde{\Delta q_t}$, and $\tilde{ca}_t$. As in Bergin and Sheffrin (2000), the predicted series fits the data substantially better than that implied by the standard PVM, although it is only 60 per cent as volatile as the actual series. Yet, the statistical test strongly rejects the cross-equation restrictions at any conventional level of significance. Given that the standard PVM could not be rejected at the 5 per cent significance level despite its poor fit, this suggests that passing the statistical test does not necessarily guarantee a good fit and vice versa, which raises some doubt regarding the usefulness of the Wald test as an overall assessment of the matching performance of present-value models.

To evaluate the PVM augmented with terms of trade, we estimate the parameter γ along with the parameters σ, ε, and κ by minimizing the RMSE associated with the predicted current account series. Equation (18) states that the effect of the terms of trade on the current account is inversely proportional to the value of γ. In the limiting case where $\gamma = 1$, the current account does not depend on the terms of trade at all. Our estimation procedure yields a point estimate of γ equal to 0.991, suggesting that terms of trade do not matter for the current account. Table 3 shows that the RMSEs associated with the PVM with and without terms of trade are essentially the same. This is illustrated in Figure 5, which shows that the current account series predicted by the two models are almost identical, confirming that terms-of-trade fluctuations are irrelevant to the Canadian current account.

Overall, these findings corroborate earlier results reported by Otto (2003), who uses a structural VAR approach to test for the presence of an HLM effect in a large sample of small open economies. Although he finds strong evidence for the existence of such an effect for the majority of countries, his results indicate that Canada is an outlier, in that terms of trade were found to have no significant effect on the Canadian trade balance. In addition, variance-decomposition results reported by Cashin and McDermott (2002) and Otto (2003) indicate that terms-of-trade shocks are not important in explaining current account movements in Canada.[21]

21. Using panel data from the G-7 countries and a different methodology, İşcan (2000) also finds little evidence that the terms of trade affect the current account.

Figure 4
Actual Canadian current account and the prediction of the PVM without terms-of-trade variations

Note: TOT = terms of trade.

3 Robustness Analysis

This section investigates the robustness of our results to the use of an alternative measure of the terms of trade. The terms-of-trade index used in this paper is constructed using unit values (value of imports/exports divided by some measure of volume), not properly weighted transactions prices. Such estimates are potentially biased measures of relative prices, because goods that are not traded or are relatively less traded because their relative price is too high are given zero or little weight in the index. In theory, however, the relative prices should be weighted by production, not trade, shares.[22] To check whether this issue is responsible for the lack of evidence of an HLM effect in Canada, we test the PVM (equation (18)) using the relative non-energy commodity price index as a proxy for the terms of trade.[23] With this new measure, the correlation between the ratio of the current account to output and changes in the terms of trade is now equal to

22. We thank Lawrence Schembri for bringing this point to our attention.
23. This variable is used as a measure of the terms of trade by the Bank of Canada and is found to have significant effects on the Canadian exchange rate.

Table 3
Tests of different versions of the PVM of the current account

Parameter	Model		
	Standard PVM	PVM without TOT	PVM with TOT
κ	0.9900	0.9993	0.9999
		(0.0823)	(0.0225)
σ	—	0.0085	0.0001
		(1.1559)	(0.1414)
ε	—	0.7246	0.7164
		(4.5193)	(4.4208)
γ	—	—	0.9911
			(1.4580)
Statistic			
RMSE	0.0964	0.0071	0.0070
Wald statistic	5.1890	31.7250	32.5020
p-value	0.0747	0.0000	0.0000
$\hat{\sigma}_{ca}/\hat{\sigma}_{ca}$	0.3859	0.6047	0.6105

Notes: Standard errors are between parentheses. For the standard PVM, the parameter η is set to 0.489. For the PVM with and without terms of trade, the parameters τ, η, and b are fixed to 0.469, 0.179, and −0.269, respectively. RMSE is the root-mean-squared error.

Figure 5
Actual Canadian current account and the predictions of the PVM with and without terms-of-trade variations

0.21. The latter series is also more positively correlated with changes in the real exchange rate, as the correlation is now equal to 0.18.

Table 4 shows that the results remain virtually unchanged when we use the alternative measure of the terms of trade. In particular, the estimate of the parameter γ is identical to the value reported in Table 3, and the cross-equation restrictions implied by the PVM (equation (18)) are strongly rejected by the data.[24] Figure 6 further shows that the terms of trade are not important in explaining the Canadian current account. This suggests that our results are robust, at least to the construction of terms-of-trade series.

Conclusion

This paper has extended the standard intertemporal model of the current account to allow for stochastic variations in three relative prices: the world real exchange rate, the real exchange rate, and the terms of trade. Previous research has shown that variations in the world real interest rate and the real exchange rate substantially improve the fit of the intertemporal model. For Canada, however, a significant portion of current account fluctuations remains unexplained even when movements in the world real interest rate and the real exchange rate are taken into account. The purpose of this paper, therefore, was to investigate whether including the terms of trade improves the ability of the intertemporal model to explain the historical path of the Canadian current account.

To do this, the paper has derived a closed-form solution for the present-value representation of the current account that highlights, in addition to the usual consumption-smoothing motive, three different channels through which movements in the real interest rate, the real exchange rate, and the terms of trade affect the current account. The restrictions implied by the extended model were subjected to present-value tests. Our results show that the extended model is strongly rejected by the data, and that terms-of-trade movements do not affect the Canadian current account in a significant way. These findings support earlier results reported by Otto (2003), who finds little evidence that terms of trade matter for the current account in Canada.

24. These results are based on a shorter sample, because the non-energy commodity price series is available only starting from 1973Q1.

Table 4
Robustness analysis: Results using an alternative measure of the terms of trade

	Model	
Parameter	**PVM without TOT**	**PVM with TOT**
κ	0.9993	0.9994
	(0.0963)	(0.0806)
σ	0.0087	0.0012
	(1.4692)	(0.5126)
ε	0.6388	0.6171
	(4.0642)	(4.1062)
γ	—	0.9895
		(1.0141)
Statistic		
RMSE	0.0075	0.0077
Wald statistic	18.6650	24.5700
p-value	0.0009	0.0001
$\hat{\sigma}_1/\hat{\sigma}_2$	0.5808	0.5585

Notes: See Table 3.

Figure 6
Actual Canadian current account and the predictions of the PVM with and without terms-of-trade variations, using an alternative measure of the terms of trade

Appendix 1
Derivation of the Log-Linearized Intertemporal Budget Constraint (Equation (14))

Our log linearization of the intertemporal budget constraint follows Kano (2003). Dividing both sides of equation (13) by $P_t^c Y_t$ gives

$$\frac{C_t^I}{P_t^c Y_t} \sum_{i=0}^{\infty} E_t R_{t,i} \frac{C_{t+i}^I}{C_t^I} = (1 + r_t)\frac{B_t}{P_t^c Y_t}$$

$$+ \frac{P_t^s NY_t^s}{P_t^c Y_t} \sum_{i=0}^{\infty} E_t R_{t,i} \frac{P_{t+i}^s NY_{t+i}^s}{P_t^s NY_t^s}. \qquad \text{(A1.1)}$$

Notice that for any variable x_t, the relation

$$\frac{x_{t+i}}{x_t} = \frac{x_{t+1}}{x_t}\frac{x_{t+2}}{x_{t+1}} \cdots \frac{x_{t+i}}{x_{t+i-1}}$$

holds. Also, from equation (2), $C_t^I / P_t^c Y_t = \varepsilon C_t / Y_t = \varepsilon \tau_t$. Therefore, the intertemporal budget constraint can be rewritten as

$$\varepsilon \tau_t \left[1 + \sum_{i=1}^{\infty} E_t R_{t,i} \prod_{j=t+1}^{t+i} \left(\frac{C_j^I}{C_{j-1}^I} \right) \right] = (1 + r_t)\frac{B_t}{P_t^c Y_t}$$

$$+ \eta_t \left[1 + \sum_{i=1}^{\infty} E_t R_{t,i} \prod_{j=t+1}^{t+i} \left(\frac{P_j^s NY_j^s}{P_{j-1}^s NY_{j-1}^s} \right) \right]. \qquad \text{(A1.2)}$$

Notice that for any variable X_t, the relation

$$\prod_{j=t+1}^{t+i} X_j = \exp\left\{ \sum_{j=t+1}^{t+i} \ln(X_j) \right\}$$

holds. From this relation and the definition of $R_{t,i}$, equation (A1.2) can be further rearranged as

$$\varepsilon \tau_t \left[1 + \sum_{i=1}^{\infty} E_t \exp\left\{ \sum_{j=t+1}^{t+i} (\Delta c_j^I - r_j) \right\} \right] = \exp(r_t) b_t$$

$$+ \eta_t \left[1 + \sum_{i=1}^{\infty} E_t \exp\left\{ \sum_{j=t+1}^{t+i} (\Delta \ln p_j^{\tilde{}} + \Delta n y_j^{s} - r_j) \right\} \right], \quad \text{(A1.3)}$$

where $(1 + r_t) = \exp\{\ln(1 + r_t)\} = \exp(r_t)$ and $b_t \equiv B_t / (P_t^c Y_t)$.

Taking a first-order Taylor expansion of the LHS of equation (A1.3) around the mean values gives

$$\widetilde{\text{the LHS}} \approx \frac{\varepsilon}{1-\alpha} \tilde{\tau}_t + \frac{\varepsilon \tau}{1-\alpha} \sum_{i=1}^{\infty} \alpha^i E_t \{ \widetilde{\Delta c_{t+i}^{I}} - \tilde{r}_{t+i} \}, \quad \text{(A1.4)}$$

where

$$\alpha = \exp\left(g^{C^I} - r \right)$$

is assumed to be less than 1. The RHS of equation (A1.3) is also approximated as

$$\widetilde{\text{the RHS}} \approx \exp(r)\tilde{b}_t + \exp(r) b \tilde{r}_t + \frac{\eta_t}{1-\kappa} \sum_{i=1}^{\infty} \kappa^i E_t \{ \widetilde{\Delta p_{t+i}^{I}}$$

$$+ \widetilde{\Delta n y_{t+i}^{s}} - \tilde{r}_{t+i} \} + \frac{1}{1-\kappa} \tilde{\eta}_t, \quad \text{(A1.5)}$$

where $\kappa = \exp(g^P + g^{NY} - r)$ is assumed to be less than 1. From equations (A1.4) and (A1.5), we have

$$\varepsilon \tilde{\tau}_t - \frac{1-\alpha}{1-\kappa} \tilde{\eta}_t \approx (1-\alpha)\exp(r)\tilde{b}_t + (1-\alpha)\exp(r) b \tilde{r}_t$$

$$-\varepsilon \tau \sum_{i=1}^{\infty} \alpha^i E_t [\widetilde{\Delta c_{t+i}^{I}} - \tilde{r}_{t+i}] + \eta \frac{1-\alpha}{1-\kappa} \sum_{i=1}^{\infty} \kappa^i E_t$$

$$[\widetilde{\Delta n y_{t+i}^{s}} - \tilde{r}_{t+i} + \widetilde{\Delta p_{t+i}^{I}}],$$

which is equation (14) in the main text.

Appendix 2
Derivation of the Present-Value Model (Equation (18))

For simplicity, assume that the economy is on a balanced growth path: the growth rate of the tradable consumption basket is the same as that of the exportable net output. That is, $\alpha = \kappa$. Then, substituting equation (16) into the intertemporal budget constraint (equation (14)) yields

$$\varepsilon\tilde{\tau}_t - \tilde{\eta}_t = (1-\kappa)\exp(r)\tilde{b}_t + (1-\kappa)\exp(r)b\tilde{r}_t - [\eta + \varepsilon\tau(\sigma - 1)]$$

$$\sum_{i=1}^{\infty} \kappa^i E_t \tilde{r}_{t+i} + \eta \sum_{i=1}^{\infty} \kappa^i E_t \widetilde{\Delta ny^*_{t+i}} - \varepsilon\tau(1-\sigma)(1-\varepsilon)$$

$$\sum_{i=1}^{\infty} \kappa^i E_t \widetilde{\Delta q_{t+i}} + \eta \sum_{i=1}^{\infty} \kappa^i E_t \widetilde{\Delta q^*_{t+i}}. \tag{A2.1}$$

To derive the optimal current account ratio equation, divide both sides of the current account identity (equation (17)) by $P^C_t Y_t$; this yields

$$ca_t \equiv \frac{CA_t}{P^C_t Y_t} = \{\exp[\ln(1+r_t)] - 1\}b_t + \eta_t - \varepsilon\tau_t = [\exp(r_t)$$

$$- 1]b_t + \eta_t - \varepsilon\tau_t.$$

Taking a first-order Taylor expansion of this equation gives

$$\tilde{ca}_t([\exp(r) - 1]\tilde{b}_t + \exp(r)b\tilde{r}_t + \tilde{\eta}_t - \varepsilon\tilde{\tau}_t). \tag{A2.2}$$

Substituting (A2.1) into (A2.2) and using equation (9) yields the optimal current account ratio,

$$\tilde{ca}_t = [\kappa\exp(r) - 1]\tilde{b}_t + \kappa\exp(r)b\tilde{r}_t + [\eta - \varepsilon\tau(\sigma - 1)] \sum_{i=1}^{\infty} \kappa^i E_t \tilde{\tau}_{t+i}$$

$$-\eta \sum_{i=1}^{\infty} \kappa^i E_t \widetilde{\Delta ny^*_{t+i}} + \varepsilon\tau(1-\sigma)(1-\varepsilon) \sum_{i=1}^{\infty} \kappa^i E_t \widetilde{\Delta q_{t+i}}$$

$$-\eta(1-\gamma)\sum_{i=1}^{\infty}\kappa^{i}E_{t}\widetilde{\Delta p_{t+i}}.$$

Since $\kappa\varepsilon\exp(r) = \exp(g^{ny} + g^{P})$ takes a value close to one, in particular, in quarterly data, it is a reasonable approximation to set the coefficients on the first and second terms in the RHS to zero and b, respectively.

Thus,

$$\tilde{ca}_{t} = b\tilde{r}_{t} + [\eta + \varepsilon\tau(\sigma - 1)]\sum_{i=1}^{\infty}\kappa^{i}E_{t}\tilde{r}_{t+i} - \eta\sum_{i=1}^{\infty}\kappa^{i}E_{t}\widetilde{\Delta ny^{*}_{t+i}}$$

$$+\varepsilon\tau(1-\sigma)(1-\varepsilon)\sum_{i=1}^{\infty}\kappa^{i}E_{t}\widetilde{\Delta q_{t+i}} - \eta(1-\gamma)\sum_{i=1}^{\infty}\kappa^{i}E_{t}\widetilde{\Delta p_{t+i}},$$

which is equation (18) in the main text.

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Discussion

Gregor Smith

The main finding of the study by Bouraker and Kano is that changes in the terms of trade probably do not cause changes in Canada's current account. I think this finding is correct, and I have nothing but praise for their work. In this discussion, I shall first give a simple explanation of their approach, for their paper is quite technical. I shall then conclude with suggestions on where to look for explanations of the thus far unexplained volatility in the current account.

Abridged Version

Present-value models of the current account begin by taking output and the terms of trade as given. Figuring out a path for consumption spending then implies a path for international borrowing. To see how this approach works, suppose that there are two time periods. Suppose also that a country begins with net foreign assets B_0, imports to consume, and exports NY^s at relative price P (the terms of trade) to pay for that:

$$C_1 + \frac{C_2}{1+r} = (1+r)B_0 + P_1 NY_1^s + \frac{P_2 NY_2^s}{1+r}. \tag{1}$$

You can see that terms-of-trade shocks affect the national budget just like output shocks do. With consumption smoothing, consumption will respond more to permanent than to temporary shocks, and so the current account will do the opposite.

Formally, $C_1 = C_2$ implies:

$$C_1 = \frac{1+r}{2+r}\left[(1+r)B_0 + P_1 NY_1^s + \frac{P_2 NY_2^s}{1+r}\right]$$

$$= \frac{1}{2+r}B_0 + \frac{1+r}{2+r}P_1 NY_1^s + \frac{P_2 NY_2^s}{2+r}. \tag{2}$$

The current account becomes:

$$CA_1 = TB_1 + rB_0$$

$$= P_1 NY_1^s - C_1 + rB_0$$

$$= P_1 NY_1^s - \frac{1+r}{2+r}\left[(1+r)B_0 + P_1 NY_1^s + \frac{P_2 NY_2^s}{1+r}\right] + rB_0$$

$$= \frac{1}{2+r}[P_1 NY_1^s - P_2 NY_2^s] - \frac{1}{2+r}B_0. \tag{3}$$

If a terms-of-trade shock is permanent—in other words, if both P_1 and P_2 change—then the current account does not move in response. [Note: My simple example rules out effects of the terms of trade via changes in the interest rate or substitution between non-traded goods and imports.]

Econometric Methods

This toy current account model (3) reflects saving for a rainy day; an expected decline in export earnings in the future leads to a larger current account balance today. But of course $P_2 NY_2^s$ is not perfectly known in advance. Imagine trying to forecast it using an autoregression:

$$P_2 NY_2^s = \rho_1 P_1 NY_1^s, \tag{4}$$

with a coefficient ρ_1. To see how the econometric, cross-equation restrictions arise, focus on the trade balance. Using our forecast (4) to replace $P_2 NY_2^s$ in the theory (3) gives:

$$TB_1 = \frac{1}{2+r}P_1 NY_1^s(1-\rho_1). \tag{5}$$

This result shows that the response of the trade balance (and current account) is larger the less persistence there is in export earnings (the lower is

the value of ρ_1). Again, if all changes are permanent, then $\rho_1 = 1$, and the changes lead to no movement in the current account. One way to test the theory would be to estimate these two equations (4) and (5) and to determine whether ρ_1 is the same in both of them.

A second way to test the theory begins by including more information in the forecasts. Here, then, is a second possible forecasting model:

$$P_2 NY_2^s = \beta_0 + \beta_1 P_1 NY_1^s + \beta_2 TB_1 . \tag{6}$$

It is natural to include TB_1, for, according to the theory (3), the trade balance partly reflects the expected future value of export earnings. Now the predicted trade balance is:

$$\begin{aligned} TB_1 &= \frac{1}{2+r}[P_1 NY_1^s - \beta_0 - \beta_1 P_1 NY_1^s - \beta_2 TB_1] \\ &= \frac{\beta_0}{2+r} + \left[\frac{1}{2+r} - \beta_1\right] P_1 NY_1^s - \frac{\beta_2}{2+r} TB_1 . \end{aligned} \tag{7}$$

If the predicted trade balance is to be equal to the actual one, then $\beta_1 = 1/(2+r)$ and $\beta_2 = -(2+r)$. Equivalently, in my toy example, simply rearranging the theory gives the optimal forecast of future export earnings as:

$$E_1 P_2 NY_2^s = P_1 NY_1^s - (2+r) TB_1 , \tag{8}$$

so the theory restricts the two coefficients in this forecasting regression. These are the restrictions that are formally tested by Bouakez and Kano, and rejected.

Notice that this optimal forecast (8) does not provide information directly on the persistence properties of the terms of trade: β_1 does not appear. Let us look at the persistence directly. If we run a regression like the first one (4) in the Bouakez-Kano terms-of-trade series, we get $\hat{\rho}_1 = 0.911$ (0.03), or with the alternative series, $\hat{\rho}_1 = 0.968$ (0.02). Looking back at the trade-balance equation (6), you will see that this means the theory predicts very little response in the trade balance or the current account, which is what Bouakez and Kano find. My forecasting model (4) is very simple, though. It would be interesting to decompose the terms of trade into permanent and temporary components to check on the relative importance of these two types of changes.

Bouakez and Kano's equation (18) includes these terms:

$$\tilde{ca}_t = -\eta \sum_{i=1}^{\infty} \kappa_i E_t \Delta n y^{\mathrm{t}}_{t+i} \ldots - \eta(1-\gamma) \sum_{i=1}^{\infty} \kappa_i E_t \Delta p_{t+i}. \qquad (9)$$

The first term is the one traditional to this approach, while the second one is due to the terms of trade. Bouakez and Kano find $\hat{\gamma} = 1$, so the second term plays no role. Note that γ appears nowhere else in the equation—it is measuring this response only—so this negative finding does not depend on some weird over-identification. Goodger (2004) studies Canada, Australia, the Netherlands, and the United Kingdom, using a calibrated version of the present-value model. He too finds no role for terms-of-trade shocks for any of these countries.

In sum:

(i) shocks to the terms of trade have been quite persistent, so the insurable part has been small; and

(ii) statistically, the response of international borrowing and lending to this insurable part is zero.

Finally, here is another way of thinking about the absence of an effect of the terms of trade. Bouakez and Kano report that the correlation between ca/y and changes in the terms of trade is less than 0.05. We know that the theory involves other lags as well. We also know that it is the correlation between the terms of trade and the part of the current account that cannot be explained by other variables that is at issue. Nevertheless, with this low, contemporary correlation, it would take truly heroic (i.e., wrong) econometrics to identify a significant relationship.

What Is Missing?

Measuring the effect of the terms of trade on the current account requires a statistical model that fits historical data well. But these present-value models always seem to be rejected in formal tests. The models are still around, because (i) they track the low-frequency movements in the data, and equivalently, (ii) they find significant roles for output fluctuations and (to a lesser extent) for real interest rates and real exchange rates. But, as is well known, they cannot match the range of variability in the actual current account. The figures in the Bouakez-Kano paper illustrate these features very well.

Given these problems in fitting the ca/y series, should we be suspicious of the Bouakez-Kano findings? I do not think so. It is unlikely that this finding arises because of some omitted variables. Imagine the current account this way:

$$CA = S(P, G) - I(P, z), \tag{10}$$

where P is the terms of trade, and G is another variable—omitted from the present study—that affects national saving. Investment potentially is affected by the terms of trade and also by country-specific productivity changes, z.

Consider the saving side of the equation. Excluding this G-effect on the current account would influence the conclusion about the terms-of-trade effect only if it is correlated with both the terms of trade and the current account. Its absence will not affect $\hat{\gamma}$ in the linear, statistical model (9) if it affects the current account, but is unrelated to the terms of trade. Measures of fiscal policy might fortuitously be correlated with the terms of trade—so that their omission would potentially bias $\hat{\gamma}$—but Nason and Rogers (2003) show that it is quite difficult to find evidence of large fiscal-policy effects on the current account.

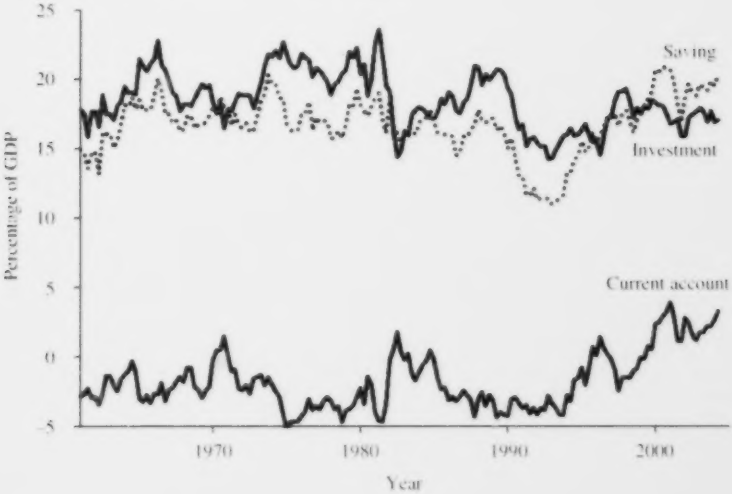
What about investment? Again, it is possible that saving—the part of the current account modelled in this study—does respond to the temporary component of the terms of trade, but that there is an offsetting response from investment so that the net effect is zero. However, İşcan (2000) finds little effect of the terms of trade on investment (or the current account).

One concludes that focusing on the terms of trade will not improve our explanations of the swings in the current account. So what will? I suggest that we turn to models of investment, rather than refining present-value models based on the permanent-income hypothesis for consumption. The statistical studies by İşcan (2000) and Marquez (2002) are two of the surprisingly few in this area. They find significant roles for national productivity in explaining changes in the current account.

General-equilibrium models like those of İşcan (2000) and Letendre (2004) study the Canadian current account by trying to predict output, investment, and saving jointly, rather than taking output as given as the traditional, present-value models do. Letendre's approach includes world real interest rates and productivity shocks. He tracks the Canadian trade balance quite well, and perhaps better than the traditional, present-value model does. But his model does not track investment well, so it leaves plenty of work still to do.

Figure 1 shows Canadian saving and investment shares from 1961 into 2004. The investment share excludes government investment, and is given by 100(V498095+V498100)/V498074. The current account share is given by 400(V114421/V498074) from CANSIM II.

Figure 1
Saving and investment shares of GDP



I have deliberately rigged the diagram so that the investment share and the current account are shown with the same dark line, to enhance the impression that these curves mirror each other and most of the variation in the current account is due to variation in investment rather than saving. In fact, the variances are linked like this:

$$var\left(\frac{CA}{Y}\right) = var\left(\frac{S}{Y}\right) + var\left(\frac{I}{Y}\right) - 2cov\left(\frac{S}{Y}, \frac{I}{Y}\right)$$

$$4.038 = 4.426 + 4.089 - 4.477. \qquad (11)$$

Fluctuations in the investment and saving shares of GDP give rise to roughly the same amounts of variation in the current account. Still, investment decisions are a natural focus for anyone interested in explaining the volatility in the current account.

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The Current Account and the Interest Rate Differential in Canada

Martin Boileau and Michel Normandin

Introduction

The analysis of the current account and the real interest rate differential have been important enterprises. From a policy-maker's point of view, the current account is important, because it provides information about the amount of foreign resources that must be borrowed to fund domestic investment, and as such, it informs on the changes in foreign indebtedness. The interest differential is important, because it yields information on the real cost of borrowing at home, relative to the real cost of borrowing abroad. It is generally agreed that (monetary) stabilization policies must alter the interest differential to affect the course of the business cycle in open economies.

Interestingly, the vast majority of academic studies ignore the relationship between the current account and the interest differential. This is surprising, because current accounts and interest rates should jointly adjust to ensure the equilibrium of the world capital market. Instead, most of the literature on the current account aims to either test the intertemporal approach to the balance of payments (which generally assumes a constant interest rate) or to test the extent of international capital mobility. Likewise, most of the literature on the interest differential aims at testing real interest parity and at investigating the role played by the real exchange rate.

There are notable exceptions, however. The empirical studies of Bernhardsen (2000) and Lane and Milesi-Ferretti (2002) do link the current account and the interest differential. Using panel data for 12 European countries, Bernhardsen finds that a deterioration in the current account raises

the interest differential. Using panel data for 66 countries, Lane and Milesi-Ferretti find that the interest differential is inversely related to the net foreign asset position. This suggests that a deterioration of the current account that worsens the net foreign asset position raises the interest differential. Our own previous theoretical work, Boileau and Normandin (2003), studies the relationship between the business cycle fluctuations of the current account and those of the interest differential. We show that a simple multi-country model, where international financial markets are incomplete and costly to operate, yields an interest differential that is inversely related to the net foreign asset position. We also show that our multi-country model provides a good description of the relationship between the current account and the interest differential in 10 developed countries.

In this paper, we study the joint business cycle fluctuations of output, the current account, and the interest differential in post-1975 Canadian data. It is often argued that the Canadian economy is better represented as a small open economy rather than a large economy. If this is the case, our two-country model might not apply to the Canadian case. For this reason, we study a small open economy model of Canada similar to those in Letendre (2004) and Nason and Rogers (2003). The small open economy is populated by a representative consumer, a firm, and a government. Agents in the small open economy have access to world international financial markets. In using these markets, agents generate movements in the current account. In their international financial transactions, however, agents face a country-specific real return on their holdings of (world) foreign assets. The difference between the country-specific return and the world return is the interest differential. In using international financial markets, agents also affect movements in the interest differential.

We study three versions of the model of the small open economy. The first version uses our baseline parameterization. It assumes that the interest differential depends exclusively on the net foreign asset position. As in Senhadji (1997), we assume that a worsening of the small open economy's net foreign asset position raises the country-specific return above the world return and thus raises the interest differential. That is, agents in the small open economy face an upward sloping supply of foreign funds. When the small open economy borrows on financial markets (a current account deficit), it can do so at an increasing cost of borrowing. This assumption is supported by the empirical work on capital flows by Lane and Milesi-Ferretti (2002).

The second version uses the debt-output-ratio parameterization. The debt-output-ratio version modifies the baseline version by assuming that the interest differential depends on the net foreign asset to output ratio. We

study this version of the interest differential because it is widely used in the literature (see, for example, Letendre (2004), Nason and Rogers (2003), and Schmitt-Grohé and Uribe 2003). In this version, the interest differential worsens with a deterioration in the net foreign asset position. A rise in home output, however, improves the ability to support a higher foreign debt and reduces the foreign premium or interest differential.

Finally, the last version uses the habit-formation parameterization. The habit-formation version modifies the baseline version by assuming that the preferences of consumers exhibit habit formation. We study this version of consumer preferences because it has been shown to be important in understanding asset returns and the business cycle (see, for example, Boldrin, Christiano, and Fisher (2001)). Habit formation is often perceived as essential in explaining observed asset returns. It would then seem an important component to explain the interest differential.

We find that the baseline version of the model offers a good description of the joint business cycle features of output, the current account, and the interest differential for post-1975 Canadian data. In particular, the baseline version correctly predicts that the current account and the interest differential are less volatile than output, and that the current account is countercyclical while the interest differential is procyclical. The baseline version also correctly predicts the shape of the cross-correlation functions between the current account and the interest differential, between output and the current account, and between output and the interest differential. Importantly, it correctly predicts that correlations between lags of the current account and the interest differential are negative, while the correlations between leads of the current account and the interest differential are positive. This asymmetric shape of the cross-correlation function resembles a horizontal S. This S-curve encompasses the negative relationship between the current account and the interest differential discussed in Bernhardsen (2000), Boileau and Normandin (2003), and Lane and Milesi-Ferretti (2002). Admittedly, the baseline version is not perfect. In particular, it underpredicts the relative volatility of the current account and overpredicts the relative volatility of the interest differential.

In contrast, we find that the debt-output-ratio version and the habit-formation version do not offer a good description. The debt-output-ratio version incorrectly predicts that the interest differential is almost as volatile as output and that it is countercyclical. The habit-formation version of the model also incorrectly predicts that the interest differential is almost as volatile as output. In addition, it incorrectly predicts that the current account is procyclical.

Overall, our baseline version of the small open economy model offers the best description of the business cycle fluctuations of output, the current account, and the interest differential in post-1975 Canadian data. Our results contrast with those in earlier work in two directions. First, the baseline model is driven almost exclusively by productivity shocks. That is, government expenditures and world real interest rate shocks play only a small role. This contrasts with Nason and Rogers (2003), who argue that government expenditures and world real interest rate shocks are important to explain the Canadian experience. Second, the baseline model assumes that the interest differential is inversely related to simply the net foreign asset position. This contrasts with Boileau and Normandin (2003), where the differential is as in the debt-output-ratio version of the model.

Section 1 presents the small open economy model of Canada. The three versions of the model correspond to three distinct parameterizations. Section 2 presents simulation results for the three versions of the model. We first study the dynamic responses of output, the current account, and the interest differential to the various shocks in the model. We then examine the business cycle statistics generated by the three versions of the model, and we compare these statistics to those of post-1975 Canadian data. Finally, we study the robustness of these results for the baseline model. The final section concludes.

1 A Small Open Economy Model

In this section, we develop the small open economy model and discuss its parameterization. The economy is that of a small country open to world financial markets. Financial markets, however, are incomplete. In addition, the agents in the small open economy face a country-specific interest rate on their net holdings of foreign (world) assets.

1.1 The model

The small country is populated by a representative consumer, whose expected lifetime utility is given by

$$E_t\left[\sum_{t=0}^{\infty} \beta^t U(C_t - \psi C_{t-1}, N_t)\right], \tag{1}$$

where E_t is the conditional expectation operator, C_t is consumption, N_t is hours worked, and $0 < \beta < 1$. Similarly to Letendre (2004), we employ GHH preferences (Greenwood, Hercowitz, and Huffman 1988):

$$u(C_t - \psi C_{t-1}, N_t) = [C_t - \psi C_{t-1} - (\theta/\eta)N_t^{\eta}]^{\gamma}/\gamma, \tag{2}$$

where $\gamma \geq 1$, $\psi \geq 0$, $\theta > 0$, and $\eta > 1$. Importantly, these preferences exhibit habit formation only when $\psi > 0$. GHH preferences play an important role in international business cycle studies. Specifically, Correia, Neves, and Rebelo (1995) show that GHH preferences promote a countercyclical trade balance.

The production technology is constant return to scale in its inputs:

$$Y_t = Z_t K_t^{\alpha} N_t^{1-\alpha}, \tag{3}$$

where Y_t is output, Z_t is the level of total factor productivity, K_t is the capital stock, and $0 < \alpha < 1$. Capital accumulation follows

$$K_{t+1} = I_t + (1-\delta)K_t - \Phi_t K_t, \tag{4}$$

where I_t is investment and $0 < \delta < 1$. The term Φ_t denotes adjustment costs:

$$\Phi_t = \frac{\phi}{2}\left(\frac{I_t}{K_t} - \delta\right)^2, \tag{5}$$

where $\phi \geq 0$. Investment is costly only when $\phi > 0$. As in Baxter and Crucini (1995), we use adjustment costs mainly to contain the relative volatility of investment.

The current account is given by changes in the net holdings of foreign assets or changes in the net foreign asset position:

$$X_t = B_{t+1} - B_t, \tag{6}$$

where X_t is the current account and B_t is the net foreign asset position. Using the definition for the current account, the aggregate resource constraint is

$$X_t = Y_t + (R_t - 1)B_t - C_t - I_t - G_t, \tag{7}$$

where R_t is the country-specific gross return on world assets and G_t is government expenditures. For simplicity, the government runs a balanced budget, funding its expenditures with non-distortionary (lump-sum) taxes.

The country-specific return R_t differs from the world return by

$$D_t = R_t - R_t^{w}, \tag{8}$$

where D_t is the real interest differential and R_t^w is the world return. As in Boileau and Normandin (2003), Nason and Rogers (2003), and Schmitt-Grohé and Uribe (2003), we model the differential as a function of the net foreign asset position:

$$D_t = -\varphi B_t / Y_t^{\xi}, \tag{9}$$

where $\varphi \geq 0$ and $\xi \geq 0$. There is no differential when $\varphi = 0$. Also, the interest differential is only a function of the net foreign asset position when $\xi = 0$. The interest differential is a reduced-form formulation to obtain an upward sloping supply of foreign funds. As in Senhadji (1997), this may occur because of an otherwise uncaptured risk premium. As in Boileau and Normandin (2003), it may also occur because international financial markets are costly to operate.

The model has three shocks: productivity, Z_t; government expenditures, G_t; and the world return, R_t^w. The shocks are generated by

$$z_t = \rho_z z_{t-1} + \varepsilon_{zt}, \tag{10.1}$$

$$g_t = \rho_g g_{t-1} + \varepsilon_{gt}, \tag{10.2}$$

$$r_t^w = \rho_r r_{t-1}^w + \varepsilon_{rt}, \tag{10.3}$$

where $z_t = \ln(Z_t/Z)$, $g_t = \ln(G_t/G)$, and $r_t^w = \ln(R_t^w/R^w)$. The variables Z, G, and R^w are the steady-state values of productivity, government expenditures, and world return. The innovations ε_{zt}, ε_{gt}, and ε_{rt} are uncorrelated zero-mean random variables with variances σ_z^2, σ_g^2, and σ_r^2.

The model is solved using a pseudo planner's problem. The pseudo planner chooses consumption, hours worked, investment, and asset holdings to maximize the expected lifetime utility of the representative consumer (equation (1)) subject to the constraints given by equations (2) to (8). Importantly, the pseudo planner takes the country-specific interest rate as given. The first-order conditions are

$$\lambda_t = U_{ht} - \psi\beta E_t[U_{ht+1}], \tag{11.1}$$

$$U_{Nt} = -\lambda_t(1-\alpha)Y_t/N_t, \tag{11.2}$$

$$\lambda_{kt} = \lambda_t/[1-\phi(I_t/K_t-\delta)], \tag{11.3}$$

$$\lambda_t = \beta E_t[\lambda_{t+1}R_{t+1}], \tag{11.4}$$

$$\lambda_{kt} = \beta E_t\left[\lambda_{t+1}\alpha\frac{y_{t+1}}{k_{t+1}} + \lambda_{kt+1}\left(1 - \delta - \Phi_{t+1}\right.\right.$$

$$\left.\left. + \phi\left(\frac{I_{t+1}}{K_{t+1}} - \delta\right)\frac{I_{t+1}}{K_{t+1}}\right)\right], \tag{11.5}$$

where λ_t and λ_{kt} are multipliers associated with the resource constraint (equation (7)) and the accumulation equation (4). Also, U_{ht} and U_{nt} are the partial derivatives of $U(H_t, N_t)$ with respect to its arguments $H_t = C_t - \psi C_{t-1}$ and N_t:

$$U_{ht} = [C_t - \psi C_{t-1} - (\theta/\eta)N_t^{\eta}]^{\gamma-1}, \tag{12.1}$$

$$U_{nt} = -[C_t - \psi C_{t-1} - (\theta/\eta)N_t^{\eta}]^{\gamma-1}\theta N_t^{\eta-1}. \tag{12.2}$$

Equation (11.1) equates the shadow price of consumption to its marginal benefit. The marginal benefit has two components. The first is the rise in utility following an immediate increase in consumption. The second is the reduction in utility coming from the future lowering of consumption below its habit level. Equation (11.2) equates the marginal cost of working an extra unit of time to its marginal benefit of higher production. Equation (11.3) translates the shadow price of new capital into its output price. Equation (11.4) equates the marginal cost of purchasing an extra unit of world assets to its discounted expected marginal benefit. Equation (11.5) equates the marginal cost of purchasing an extra unit of capital to its discounted expected marginal benefit of additional future production.

The system that characterizes the equilibrium for this model includes the set of first-order conditions (11) and the partial derivatives (12). The set is completed by the production function (equation (3)), the accumulation (equation (4)), the definition of the adjustment cost (equation (5)), the definition of the current account (equation (6)), the aggregate resource constraint (equation (7)), the interest differential described by equations (8) and (9), and the laws of motion for shocks (equation (10)).

1.2 Parameterization

The system of equations that characterizes the equilibrium does not yield an analytical solution. The equilibrium must be approximated using numerical methods. For this, we employ the log-linear approximation method described in King, Plosser, and Rebelo (2002). This method linearizes the

equations that characterize the equilibrium around the deterministic steady-state equilibrium. This linearization requires that values be assigned to all parameters.

We set a number of parameters to the values discussed in Boileau and Normandin (2003). The subjective discount factor is $\beta = 0.99$, the coefficient of relative risk aversion is $1-\gamma = 2$, the elasticity of labour supply is $1/(\eta - 1) = 1.7$, the share of capital is $\alpha = 0.36$, the depreciation rate is $\delta = 0.025$, and the responsiveness of the interest differential to the net foreign asset position is $\varphi = 0.0035$. In addition, we set the share of work parameter θ to ensure that the time devoted to work is $N = 0.30$ in the steady state.

We use the post-1975 Canadian data to set a number of parameters (see Appendix 1). We set the adjustment-cost parameter ϕ to ensure that the ratio of the standard deviation of investment to the standard deviation of output is 2.57 as in the Canadian data. We set the steady-state level of the output share of government expenditures to $G/Y = 21$ per cent as in the Canadian data. We set the steady-state level of the world real interest rate to ensure that the steady-state level of the interest differential is $D = 0.235$ per cent as in our data. Finally, the parameters of the shock processes are set to their ordinary-least-squares estimates. The estimates are $\rho_z = 0.4920$, $\rho_g = 0.5140$, $\rho_r = 0.7209$, $\sigma_z = 0.0180$, $\sigma_g = 0.0120$, and $\sigma_r = 0.0013$.

For the remaining parameters, we explore three cases. Each case represents a particular version of the model. The baseline version assumes no habit formation $\psi = 0$. It also assumes that the interest differential depends only on the net foreign asset position $\xi = 0$, as in Devereux and Smith (2002). The debt-output-ratio version modifies the baseline version by allowing the interest differential to depend on output. For this, we set $\xi = 1$ so that the interest differential depends on the debt-to-output ratio as in Boileau and Normandin (2003). Finally, the habit-formation version modifies the baseline version to allow for habit formation. To do so, we set $\psi = 0.90$ as in Boldrin, Christiano, and Fisher (2001).

2 Results

In this section, we first study the theoretical properties of the model of the small open economy. We then compare the empirical properties of the model to those of post-1975 Canadian data.

2.1 Dynamic responses

To understand the different versions of the model, we first document the dynamic responses of a number of key variables to the different shocks.

Figure 1 displays the dynamic responses in all three versions of the model. The shocks come from positive one-standard-deviation innovations to productivity, government expenditures, and the world interest rate. The key variables are the logarithm of output $y_t = \ln(Y_t/Y)$, the current account (to output ratio) $x_t = X_t/Y_t - X/Y$, and the interest differential $d_t = R_t - R_t^w - D$, where Y, X, and D are the steady-state levels of output, the current account to output ratio, and the interest differential.

At first glance, Figure 1 suggests that the economy is driven mostly by productivity shocks. The responses of the variables are the largest after the productivity shock, small after a government-expenditures shock, and almost non-existent after the world interest rate shock. Also, the three versions generate dissimilar responses after the productivity shock, but very similar responses after a government-expenditures shock and after a world interest rate shock.

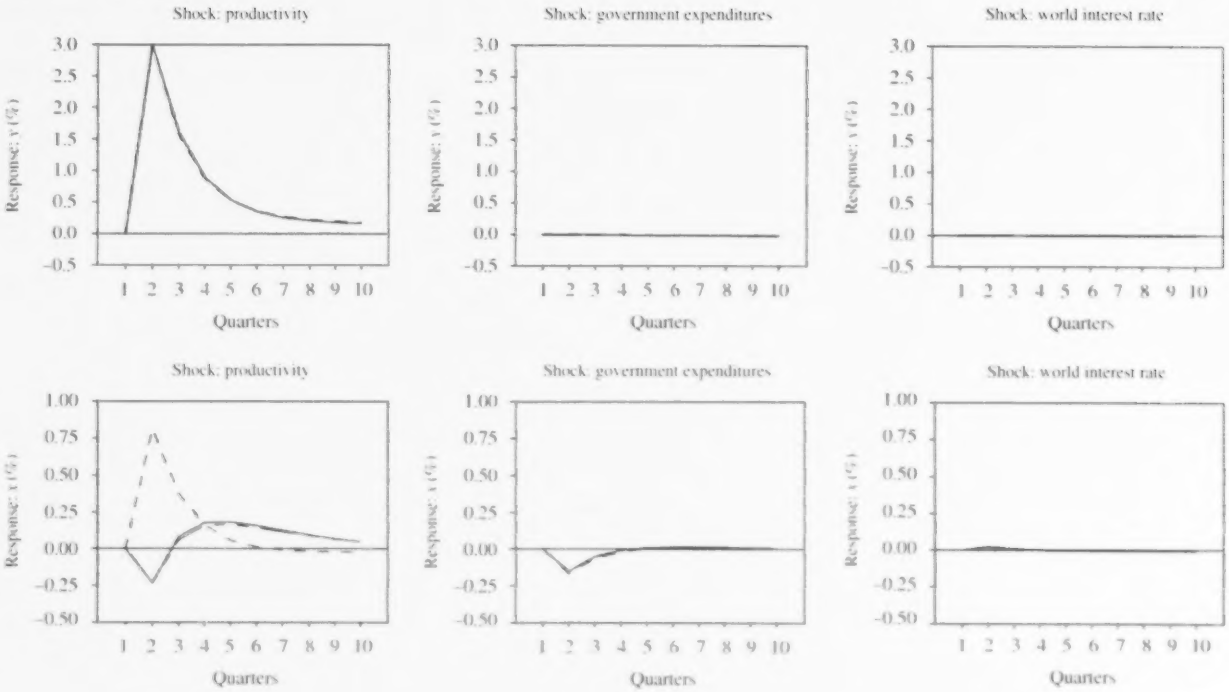
In the baseline version, an increase in productivity initially raises output, deteriorates the current account, and (with a period lag) raises the interest differential. The higher productivity stimulates both aggregate saving and investment, but saving does not rise enough to fully fund the investment boom. The result is a deterioration of the current account. The deterioration worsens the country's net foreign asset position and eventually pushes up the interest differential. Over time, the investment boom subsides, the current account improves, and the interest differential returns to its steady state.

An increase in government expenditures generates a deterioration of the current account, an eventual reduction in output, and an increase in the interest differential. Importantly, the shock does not immediately affect output. As discussed in Devereux, Gregory, and Smith (1992) and Letendre (2004), this occurs because GHH preferences ensure that output depends only on productivity and the (predetermined) capital stock:

$$Y_t = \left[\frac{(1-\alpha)}{\theta}\right]^{(1-\alpha)/(\eta-(1-\alpha))} (Z_t K_t^{\alpha})^{\eta/(\eta-(1-\alpha))}. \tag{13}$$

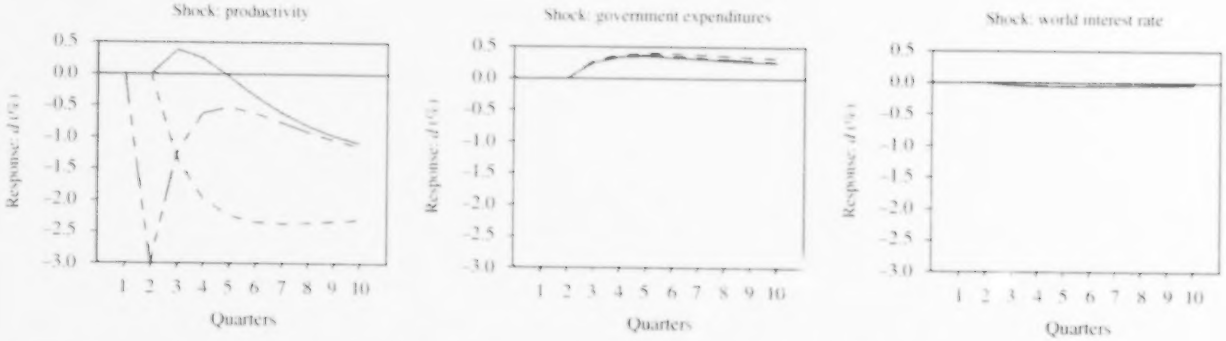
That is, output does not initially react, because neither productivity nor the capital stock initially responds to the increase in government expenditures. The higher government expenditures reduce aggregate saving and investment, but the effect is larger on saving. The result is a deterioration of

Figure 1
Dynamic responses



(cont'd)

Figure 1 (cont'd)
Dynamic responses



Notes: The solid (dashed) [dotted] lines represent the dynamic responses of y, x, and d predicted by the baseline (debt-output-ratio) [habit-formation] versions. The variables are the demeaned logarithm of output (y), the demeaned ratio of the current account to output (x), and the demeaned interest differential (d). There are three lines per graph:

——— "solid" → baseline version;
— — — "dashed" → debt-output-ratio version;
- - - - "dotted" → habit-formation version.

the current account. As before, the deterioration eventually worsens the net foreign asset position and raises the interest differential. Facing higher expected home interest rates, firms reduce investment to lower the capital stock. This eventually lowers output. Over time, the increase in government expenditures subsides, the current account improves, and the interest differential returns to its steady state.

Finally, an increase in the world interest rate improves the current account. It eventually lowers output and reduces the interest differential. The increase in the world interest rate makes foreign saving more attractive, and this improves the current account. The improvement of the current account also improves the net foreign asset position, which lowers the interest differential. The home interest rate, however, is raised, as the rise in the world interest rate dominates the reduction in the interest differential. Facing higher expected home interest rates, firms reduce investment to lower the capital stock, which eventually lowers output. Over time, the increase in the world interest rate subsides, the current account deteriorates, and the interest differential returns to its steady state.

In the debt-output-ratio version, an increase in productivity also raises output and deteriorates the current account. The increase in productivity, however, reduces the interest differential. As in the baseline version, the higher productivity generates a deterioration of the current account, which worsens the net foreign asset position. This, however, does not increase the interest differential, because the interest differential is a function of the debt-to-output ratio. The increase in output works to reduce the interest differential, while the worsening of the net foreign asset position works to raise the interest differential. Overall, the rise in output dominates, and the productivity shock generates an initial reduction in the interest differential. As in the baseline version, an increase in government expenditures generates an eventual and negligible reduction in output, an initial small deterioration of the current account, and an eventual small increase in the interest differential. Also, an increase in the world interest rate eventually reduces output, improves the current account, and eventually reduces the interest differential.

In the habit-formation version, an increase in productivity again raises output, but the rise in output is accompanied by an improvement in the current account and an eventual reduction in the interest differential. The increase in productivity raises saving by more than investment. This occurs because the habit-formation motive forces the consumer to smooth consumption. That is, the increase in productivity raises consumption, but does little to avoid the hangover that a future large reduction in consumption would bring. The result is that saving rises more than investment. The

improvement in the current account also improves the net foreign asset position, and this eventually reduces the interest differential. As in the baseline version, an increase in government expenditures generates an eventual and negligible reduction in output, an initial small deterioration of the current account, and an eventual small increase in the interest differential. An increase in the world interest rate eventually reduces output, improves the current account, and eventually reduces the interest differential.

These responses hint at important predicted features. First, they suggest that the economy is driven mostly by productivity shocks in all three versions. The responses of the key variables are the largest after the productivity shock, small after a government expenditures shock, and almost non-existent after the world interest rate shock. Second, the importance of productivity shocks suggests that output is more volatile than the current account in all three versions. That is, the responses of output are always larger than those of the current account. Third, the responses also suggest that output is much more volatile than the interest differential in the baseline version, but only slightly more volatile in the debt-output-ratio version and in the habit-formation version. The response of output is larger than the response of the interest differential in the baseline model, but not clearly so in the debt-output-ratio version and in the habit-formation version. Fourth, the importance of productivity shocks also suggests that the current account is countercyclical in the baseline version and the debt-output-ratio version, but procyclical in the habit-formation version. That is, the large initial positive response of output is accompanied by a deterioration of the current account in the baseline version and in the debt-output-ratio version, but an improvement of the current account in the habit-formation version. Fifth, although this is less clear because of the lag, the interest differential appears procyclical in the baseline version and countercyclical in the debt-output-ratio version and in the habit-formation version. The initial response of output is accompanied by an eventual rise in the interest differential in the baseline version, but a sharp current reduction in the debt-output-ratio version and an eventual reduction in the habit-formation version.

Overall, the dynamics of the model's key variables provide intuition behind the predicted business cycle features of output, the current account, and the interest differential.

2.2 Business cycle features

We now compare the business cycle features of post-1975 Canadian data to those of the three versions of the small open economy model. The Canadian quarterly data are described fully in Appendix 1. In the data, we construct

the different variables to reflect the variables from the model. In particular, output y_t is the detrended logarithm of real gross domestic product, the current account x_t is the detrended current account, and the interest differential d_t is the detrended difference between the ex ante country-specific real interest rate and the ex ante world real interest rate. As in Taylor (2002), the current account (to output ratio) is the ratio of the current account and gross domestic product. As in Boileau and Normandin (2003), the ex ante real interest rate is the difference between the short-term nominal interest rate and the expected inflation rate. As in Nakagawa (2002), the short-term nominal interest rate is the rate on short lending between financial institutions. As in Barro and Sala-i-Martin (1990), the expected inflation rate is the one-quarter-ahead predicted inflation rate from a univariate ARMA(1,1) process. Also, the world interest rate is a weighted average of the country-specific interest rates for 10 developed countries, where the weights reflect the country's share of the overall real output of the 10 countries. The variables are detrended as in Hodrick and Prescott (1997).

Table 1 reports the salient features of the business cycle fluctuations of consumption, investment, the current account, and the interest differential. These features are presented for Canadian data and the three versions of the model. The table shows relative volatility and contemporaneous correlations. The relative volatility corresponds to the ratio of the sample standard deviation of a variable to the sample standard deviation of output. The correlations are the sample contemporaneous correlation between a variable and output.

In the Canadian data, consumption, the current account, and the interest differential are all less volatile than output. Investment, however, is more volatile than output. In addition, consumption, investment, and the interest differential are procyclical, while the current account is countercyclical.

The simulated statistics from the baseline version replicate those of the Canadian data remarkably well. That is, consumption, the current account, and the interest differential are less volatile than output, but investment is more volatile than output. Also, consumption, investment, and the interest differential are procyclical, while the current account is countercyclical. The main discrepancies are that the current account is not as volatile as in the data, and that the interest differential is much more volatile than in the data. The simulated relative volatility of the current account is only 25 per cent that of the historical relative volatility. The simulated relative volatility of the interest differential is 2.7 times larger than the historical relative volatility.

The simulated statistics for the debt-output-ratio version do not replicate those of the Canadian data very well. Recall that the model assumes that the

Table 1
Business cycle statistics

	Relative volatility				Correlation			
	c	i	x	d	(c, y)	(i, y)	(x, y)	(d, y)
Data	0.72	2.57	0.53	0.17	0.83	0.78	−0.15	0.54
Baseline	0.80	2.57	0.13	0.46	0.99	0.98	−0.42	0.44
	(0.00)	(0.03)	(0.01)	(0.05)	(0.01)	(0.00)	(0.07)	(0.06)
Debt-output ratio	0.80	2.57	0.13	0.91	0.99	0.98	−0.46	−0.90
	(0.00)	(0.03)	(0.01)	(0.03)	(0.00)	(0.00)	(0.07)	(0.02)
Habit formation	0.17	2.57	0.28	0.91	0.42	0.99	0.97	0.14
	(0.01)	(0.01)	(0.01)	(0.08)	(0.01)	(0.00)	(0.00)	(0.04)

Notes: Entries under relative volatility and correlation refer to the standard deviation of the variable relative to the standard deviation of y and to the contemporaneous correlation between variables. Entries in parentheses are the standard deviations of the business cycle statistics. The variables are the detrended logarithms of output (y), consumption (c), and investment (i), as well as the detrended ratio of the current account to output (x), and the detrended interest differential (d). The detrending method is the Hodrick-Prescott (1997) filter. The interest differential is constructed from ex ante real interest rates, using a one-quarter-ahead predicted inflation rate from an ARMA(1,1) process.

interest differential is a function of the net foreign asset position to output ratio, instead of simply the net foreign asset position. The influence of output on the interest differential appears to deteriorate the ability of the model to explain the Canadian data. In particular, the added output more than doubles the already too large relative volatility of the interest differential. The result is that the simulated relative volatility of the interest differential is now 5.4 times larger than the historical relative volatility. In addition, adding output implies that the simulated interest differential wrongly becomes countercyclical.

The simulated statistics for the habit-formation version also do not replicate those of the Canadian data well. The main benefit of the habit-formation assumption is to raise the too-low relative volatility of the current account. The simulated relative volatility is now 53 per cent that of the historical relative volatility. This benefit, however, comes at a high cost. The assumption of habit formation seriously reduces the relative volatility of consumption, while raising that of the interest differential. The simulated relative volatility of the interest differential is 5.4 times larger than the historical relative volatility. The habit-formation assumption also lowers the procyclicality of consumption and the interest differential, while it wrongly makes the current account procyclical.

To further explore the co-movements between output, the current account, and the interest differential, Figure 2 displays the dynamic cross-correlation functions between these variables. It shows the cross correlations between

Figure 2
Cross-correlation functions

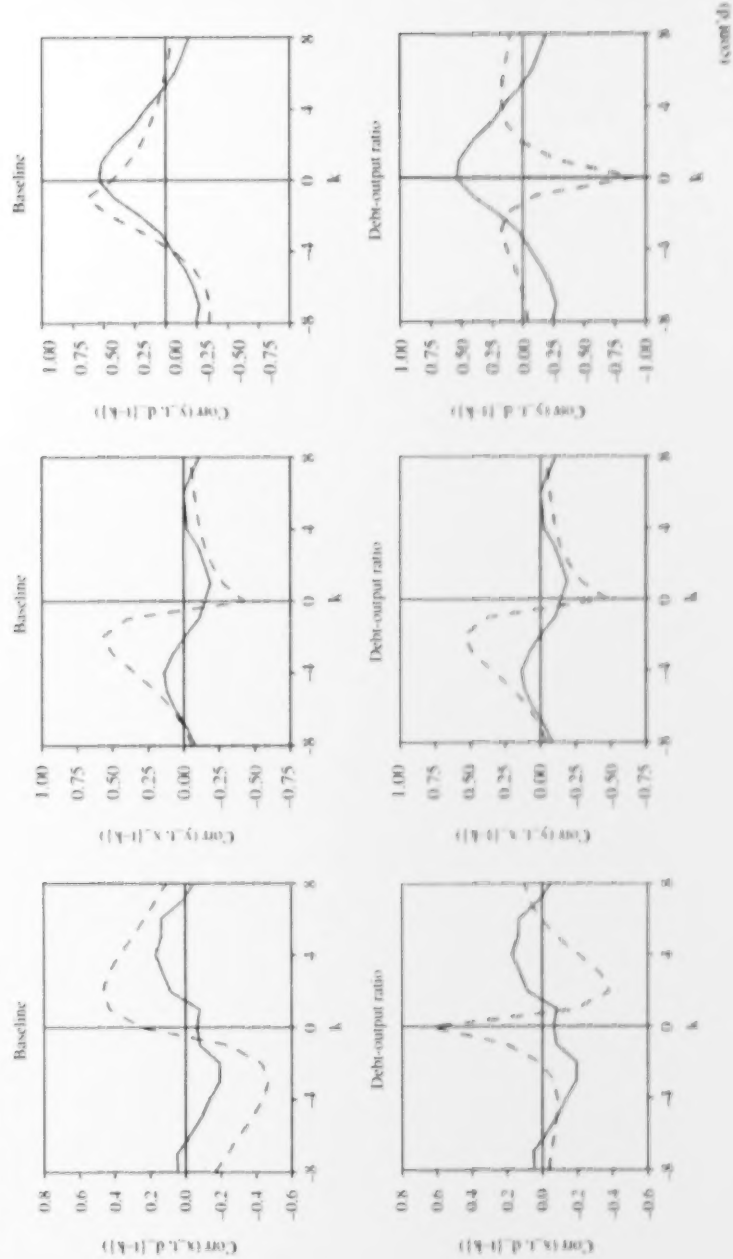
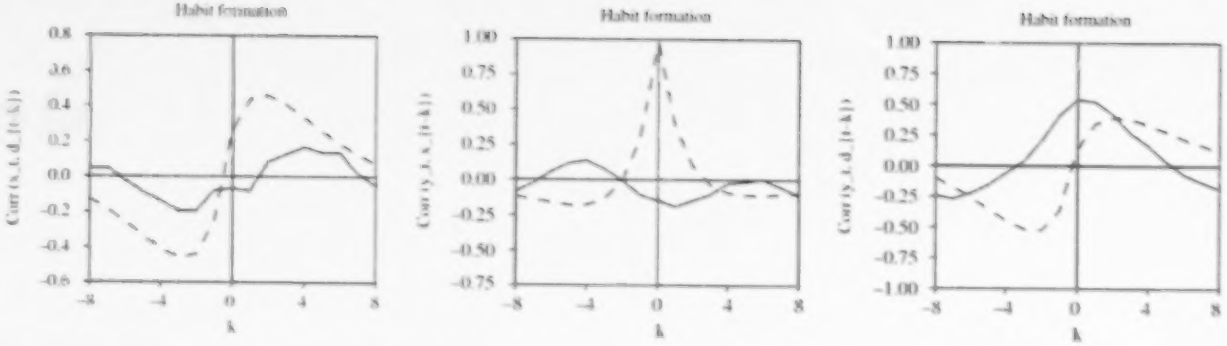


Figure 2 (cont'd)
Cross-correlation functions



Notes: The solid lines are cross correlations computed from the Canadian data. The dashed lines correspond to the cross correlations predicted by three versions of the model.

There are three lines per graph:

——— "solid" → baseline version;

— - - — "dashed" → debt-output-ratio version;

- — - - "dotted" → habit-formation version.

the current account to output ratio and the interest differential, between output and the current account, and between output and the interest differential. The different panels present both the historical cross correlations and the simulated cross correlations produced by the different versions of the model.

In the Canadian data, the cross-correlation function between the current account and the interest differential forms an asymmetric shape, reminiscent of a clockwise rotated S or a horizontal S. That is, the correlations between lags of the current account and the interest differential are negative, but the correlations between leads of the current account and the interest differential are positive, with the turning point occurring at the two-quarter lead. The cross-correlation function between output and the current account also has an asymmetric shape. The correlations between lags of output and the current account are mostly positive, while correlations between leads of output and the current account are negative. The turning point occurs at the two-period lag. Also, the current account is a leading indicator of the business cycle (i.e., the largest absolute correlation appears at the one-period lead). Finally, the cross-correlation function between output and the interest differential resembles a bell with a peak at no leads or lags (the contemporaneous correlation). That is, the interest differential is a coincident indicator of the business cycle.

The simulated cross-correlation functions for the baseline version again match those of the Canadian data remarkably well. The model predicts a sharp S-curve for the cross-correlation function between the current account and the interest differential. In particular, the predicted correlations between lags of the current account and the interest differential are negative, and the correlations between leads of the current account and the interest differential are positive. The turning point, however, occurs at the contemporaneous correlation. The model also predicts a sharp asymmetric shape for the cross-correlation function between output and the current account. The correlations between lags of output and the current account are positive, while correlations between leads of output and the current account are positive. The turning point again occurs at the contemporaneous correlation. Finally, the cross-correlation function between output and the interest differential resembles a bell with a positive peak at the two-quarter lag.

The simulated cross-correlation functions for the debt-output-ratio version fail to match those of the Canadian data. The model does not predict an asymmetric S-curve for the cross-correlation function between the current account and the interest differential. Instead, it displays a positive peak at the contemporaneous correlation. The debt-output-ratio version predicts an asymmetric shape for the cross-correlation function between output and the

current account that is very similar to that of the baseline version. The cross-correlation function between output and the interest differential resembles an inverted bell. Instead of a peak, it has a trough at the contemporaneous correlation.

Finally, the simulated cross-correlation functions for the habit-formation version also fail to match those of the Canadian data. The model predicts an asymmetric S-curve for the cross-correlation function between the current account and the interest differential. The model, however, predicts a tent-shaped cross-correlation function for output and the current account. The function peaks at the contemporaneous correlation. Also, the model predicts an asymmetric S-shape for the cross-correlation function of output and the interest differential.

Overall, the simulated business cycle features of the baseline version of the model match the features of the Canadian data remarkably well. The simulated features of the debt-output-ratio model and of the habit-formation model, however, fail to match the features of the Canadian data.

2.3 Robustness

We finally verify the robustness of the business cycle statistics produced by the baseline version of the model. For this purpose, we conduct several experiments with alternative parameterizations of key parameters in the baseline version. Unless otherwise indicated, we let $\phi = 0.393$ as in the baseline parameterization, instead of varying ϕ to match the relative volatility of investment. The different experiments are reported in Table 2 and Figure 3.

The first experiment verifies the effects of changing the coefficient of relative risk aversion. For this experiment, we retain the baseline calibration, but lower the coefficient to $1 - \gamma = 1$ (logarithmic utility) and raise it to a high of $1 - \gamma = 10$. These values are consistent with the range studied in Mehra and Prescott (1985). The simulated business cycle statistics and cross-correlation functions are very robust to changes in the coefficient of relative risk aversion. Raising risk aversion merely lowers the relative volatility of consumption, but has otherwise few effects. In part, little occurs because changes in risk aversion do not affect the world real interest rate.

The second experiment verifies the effects of changing the elasticity of labour supply. For this, we lower the elasticity to $1/(\eta - 1) = 0.2$ and raise it to $1/(\eta - 1) = 2.5$. These values are consistent with the range discussed in Greenwood, Hercowitz, and Huffman (1988). Lowering the elasticity of labour supply seriously reduces the volatility of consumption. To absorb the extra consumption smoothing, both investment and the current account

Table 2
Business cycle statistics: Sensitivity of the baseline parameterization

	Relative volatility				Correlation			
	c	i	x	d	(c, y)	(i, y)	(x, y)	(d, y)
Baseline	0.80	2.57	0.13	0.46	0.99	0.98	−0.42	0.44
	(0.00)	(0.03)	(0.01)	(0.05)	(0.01)	(0.00)	(0.07)	(0.06)
Risk aversion								
Low $(1-\gamma=1)$	0.80	2.56	0.13	0.46	0.99	0.98	−0.43	0.43
	(0.00)	(0.03)	(0.00)	(0.05)	(0.00)	(0.00)	(0.07)	(0.06)
High $(1-\gamma=10)$	0.79	2.58	0.13	0.46	0.99	0.98	−0.42	0.44
	(0.00)	(0.03)	(0.01)	(0.05)	(0.00)	(0.00)	(0.07)	(0.06)
Labour-supply elasticity								
Low $(\frac{1}{\eta-1}=0.2)$	0.27	2.75	0.18	0.77	0.97	0.99	0.82	0.32
	(0.00)	(0.03)	(0.01)	(0.09)	(0.01)	(0.00)	(0.02)	(0.04)
High $(\frac{1}{\eta-1}=2.5)$	0.90	2.55	0.16	0.48	0.99	0.98	−0.61	0.40
	(0.00)	(0.03)	(0.00)	(0.04)	(0.00)	(0.00)	(0.05)	(0.07)
Investment adjustment costs								
Low $(\phi=0)$	0.79	14.73	3.15	4.68	0.99	0.49	−0.37	0.55
	(0.00)	(0.87)	(0.19)	(0.05)	(0.00)	(0.02)	(0.03)	(0.05)
High $(\phi=0.786)$	0.80	1.67	0.15	0.56	0.99	0.99	0.92	0.19
	(0.00)	(0.01)	(0.01)	(0.05)	(0.00)	(0.00)	(0.01)	(0.04)
Interest differential responsiveness								
Low $(\varphi=0.001)$	0.25	2.55	0.16	0.20	0.99	0.97	−0.28	0.45
	(0.00)	(0.03)	(0.01)	(0.03)	(0.00)	(0.01)	(0.08)	(0.06)
High $(\varphi=0.01)$	0.79	2.53	0.10	0.80	0.99	0.98	−0.50	0.43
	(0.00)	(0.03)	(0.00)	(0.06)	(0.00)	(0.00)	(0.06)	(0.06)

Notes: Entries under relative volatility and correlation refer to the standard deviation of the variable relative to the standard deviation of y and to the contemporaneous correlation between variables. Entries in parentheses are the standard deviations of the business cycle statistics. The variables are the detrended logarithms of output (y), consumption (c), and investment (i), as well as the detrended ratio of the current account to output (x), and the detrended interest differential (d). The detrending method is the Hodrick–Prescott (1997) filter. The interest differential is constructed from ex ante real interest rates, using a one-quarter-ahead predicted inflation rate from an ARMA(1,1) process.

become more volatile. Unfortunately, as in the habit-formation version, this translates into a more volatile interest differential and a procyclical current account. The result is that the cross-correlation functions resemble those of the habit-formation version of the model.

The third experiment verifies the effects of changing the cost of adjusting the capital stock. For this experiment, we lower the cost by setting $\phi = 0$ and raise it by setting $\phi = 0.786$. These values either eliminate the cost or double it (for a given investment). As expected, reducing the cost of adjusting the capital stock substantially raises the volatility of investment. This magnifies the volatility of the current account and of the interest differential. It also sharpens the shapes of the cross-correlation functions.

Figure 3
Cross-correlation functions: Sensitivity of the baseline parameterization

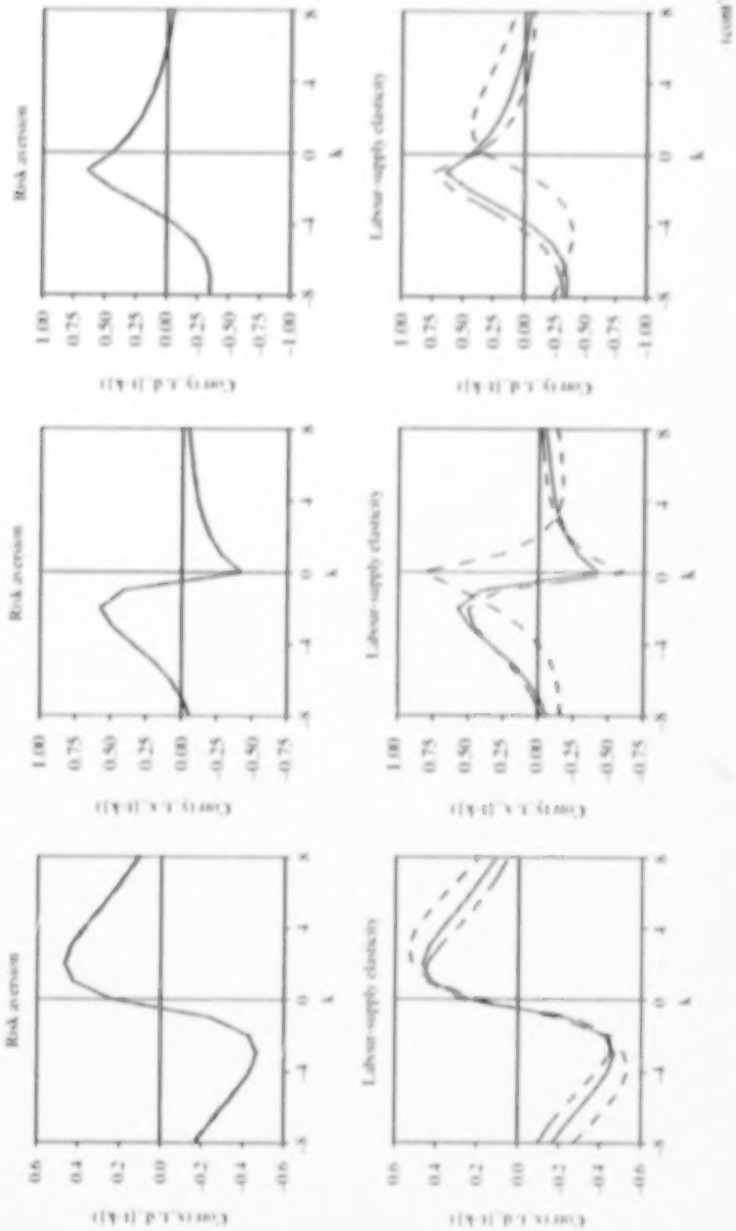
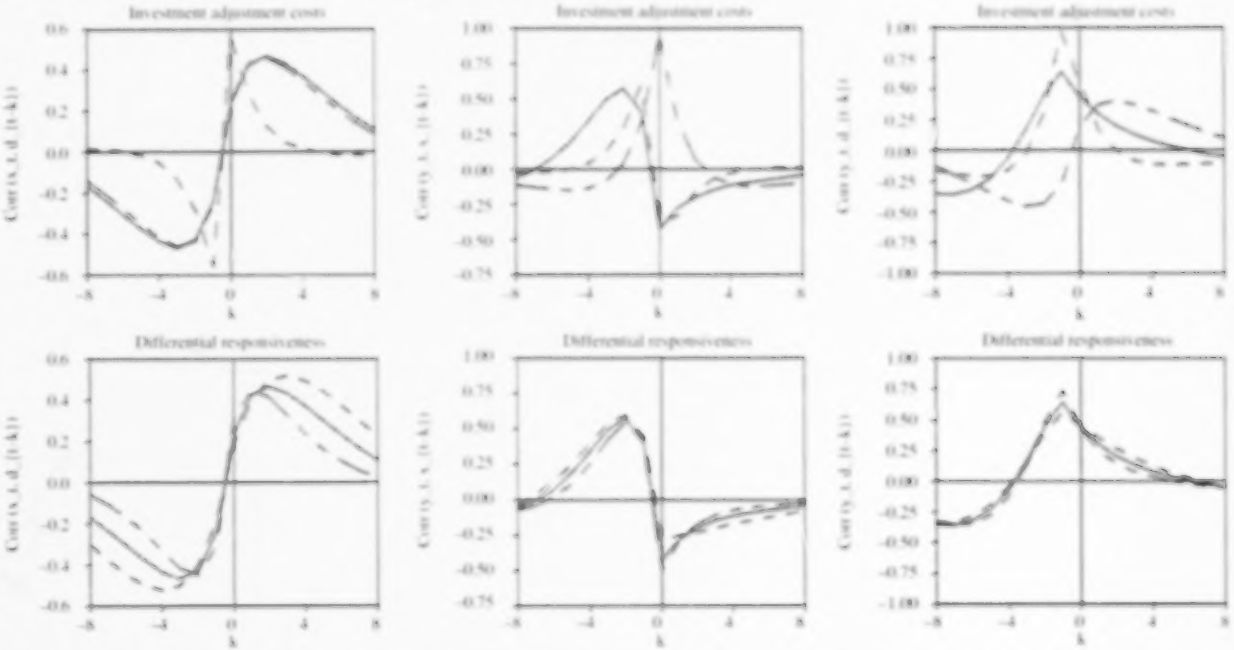


Figure 3 (cont'd)
Cross-correlation functions: Sensitivity of the baseline parameterization



Notes: The solid lines are the cross correlations computed using the baseline parameterization. The dashed (dotted) lines are the cross correlations predicted by alternative parameterizations involving low (large) values of key parameters.
There are three lines per graph:
——— "solid" → baseline version, — - - — "dashed" → debt-output-ratio version, - - - - "dotted" → habit-formation version.

Finally, the last experiment verifies the effects of changing the responsiveness of the interest differential to the net foreign asset position. We lower the responsiveness to $\varphi = 0.001$ and raise it to $\varphi = 0.01$. These values are consistent with those found in Lane and Milesi-Ferretti (2002) and used in Devereux and Smith (2002). The increase in the responsiveness raises the relative volatility of the interest differential and lowers the relative volatility of the current account. It also makes the current account more countercyclical. Finally, the increase in the responsiveness has little effect on the cross-correlation functions.

In sum, these experiments confirm that changes in the parameterization do not substantially improve the fit of the baseline version of the small open economy model.

Conclusion

The analysis of the current account and the real interest differential have been important, but separate, enterprises. This is surprising, because current accounts and interest rates should adjust jointly to ensure the equilibrium of the world capital market.

For post-1975 Canadian data, we have documented the joint behaviour of output, the current account, and the interest differential at the business cycle frequency. We have also interpreted the joint behaviour using a simple, small open economy model. Our model assumes that agents have access to world international financial markets, but face country-specific interest rates on their holdings of world assets. In our framework, the interest differential depends negatively on the country's net foreign asset position.

The small open economy model of Canada is admittedly simple, and can easily be extended. Here is a list of extensions. First, the empirical work in Baxter (1994) suggests that business cycle fluctuations in the real exchange rate are linked to fluctuations in the real interest differential. A potential extension to our analysis would be to explore this link as part of a small open economy model. Second, the empirical work in Lane and Milesi-Ferretti (2002) specifies that the real interest differential is negatively related to the net foreign asset position to exports ratio. A simple extension would be to verify whether this improves the ability of the model of the small open economy to explain the business cycle fluctuations of the current account and the interest differential. This requires that the model distinguishes between imports and exports, which is similar to the model in Senhadji (1997). Third, the empirical and theoretical work in Normandin (1999) suggests that current account deficits and government budget deficits are linked and form twin deficits. Another extension would be to study the relationship between the government budget, the current account, and the interest differential.

Appendix 1
Data

The quarterly seasonally adjusted measures are constructed for Canada over the 1975Q1 to 2001Q2 period. The measures are computed from the International Financial Statistics (IFS) released by the International Monetary Fund, as well as from the Main Economic Indicators (MEI) and the Quarterly National Accounts (QNA) published by the Organisation for Economic Co-operation and Development.

Output

Output is measured by the weighted nominal gross domestic product (GDP) in national currency (source: QNA), deflated by the all-item consumer price index (CPI) for the base year 1995 (source: MEI). Following Backus, Kehoe, and Kydland (1992), the output weight is a constant chosen to match the average of our quarterly values of output in 1985 to the yearly data on real GDP obtained from the international prices for 1985, reported by Summers and Heston (1988) (source: variables 1 and 2 in their Table 3).

Current account

The current account is the product of the output weight, the nominal current account in US dollars (source: IFS), and the nominal exchange rate of national currency units per US dollar (source: IFS), divided by the CPI. The current account is further regressed on quarter dummies, because published current account data are not seasonally adjusted.

Interest differential

The interest differential is the difference between the Canadian interest rate and the world interest rate. The country-specific interest rate is the nominal interest rate minus the expected inflation rate. The nominal interest rate is the one-quarter interbank rate (source: IFS). The expected quarterly inflation rate is the one-quarter-ahead forecast formed from a univariate ARMA(1,1) process. The world interest rate is the sum of the country-specific interest rates weighted by the country's share of the total output of 10 developed countries. As a group, these countries account for 55 per cent of the overall 1990 real gross domestic product of the 116 countries for which data are available in the Penn World Tables (Mark 5.6a). The individual countries are Australia, Austria, Canada, Finland, France, Germany, Italy, Japan, the United Kingdom, and the United States. Germany refers to West Germany and Unified Germany for the pre- and post-1990 periods.

Consumption, investment, and government expenditures

Consumption is the output weight times nominal private final consumption expenditures in national currency (source: QNA), deflated by the CPI. Investment is the output weight times nominal gross fixed capital formation in national currency (source: QNA), deflated by the CPI. Government expenditures are the output weight times nominal government final consumption expenditures in national currency (source: QNA), normalized by the CPI.

Productivity

Total factor productivity is constructed from the production function (equation (3)) using the capital share $\alpha = 0.36$, and measures of output, capital, and employment. Capital is computed from the capital-accumulation equation (4), the adjustment-cost equation (5), the depreciation rate $\delta = 0.025$, the adjustment-cost parameter $\phi = 0.393$, the steady-state value of capital (for the initial period), and investment. Employment is calculated as the civilian employment index for the base year 1995 (source: MEI) times the population in 1985 reported by Summers and Heston (1988) (source: variable 1 in their Table 3).

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Discussion

*Talan B. İşcan**

In international macroeconomics, the present-value model is a popular and elegant framework in which to consider the current account. According to this model, the current account is the saving of a country vis-à-vis the rest of the world, and movements in the current account reflect the expected *transitory* changes in domestic income, net of investment and government spending. This interpretation is the international finance analog of the permanent-income hypothesis in consumption, whereby the only motive for saving is "for a rainy day," or the life-cycle motive.

Despite its intuitive appeal, however, the present-value model of the current account is grossly inadequate for interpreting the data for Canada, a quintessential small open economy, because the model has been repeatedly rejected by formal tests.[1] While the baseline model is stylized for a number of reasons, one of its key assumptions stands out: the interest rate faced by domestic residents is equal to the exogenous world interest rate, which in turn is equal to the subjective discount rate. On empirical grounds, for both emerging and industrial countries, a constant world interest rate applicable to borrowing and lending under *all* circumstances is no doubt a poor approximation of reality. On theoretical and computational grounds, it is also often necessary to differentiate between world and domestic interest rates to generate stationary long-run equilibrium in small open economy models. Therefore, previous literature has linked domestic and foreign interest rate differentials to domestically held net foreign assets, the change

1. See, for example, Sheffrin and Woo (1990), Otto (1992), İşcan (2002), and Nason and Rogers (2003).

* Thanks to Jim Nason for very useful comments and to Cornell University for its hospitality during the writing of this discussion.

in which is the current account. However, the relationship between net foreign assets and the interest differential is typically imposed in an ad hoc fashion. Hence, Boileau and Normandin address the extent to which alternative specifications of the link between net foreign assets and the interest differential matter for interpreting the joint behaviour of the Canadian current account and the interest rate differential.

Main Findings

Boileau and Normandin use a standard real-business-cycle framework adapted to a small open economy. Table 1 summarizes the alternative specifications they consider and their main findings. They argue that a model in which the interest differential depends on net foreign asset (NFA) positions, preferences are isoelastic, and technology shocks[2] are the primary drivers of the Canadian current account and interest rate differentials performs "well." They conclude that the model:

(i) matches relative magnitudes of some but not all volatilities; and

(ii) incorporates dynamics that match the shape of the empirical cross-correlation functions between the current account and the interest rate differential, between output and the current account, and between output and the interest rate differential.

While some economists may find this moment-matching exercise archaic and may have quibbles with filtering of the current account and the interest differential data, I think the results are interesting. The exercise chooses the most parsimonious model and gives a mono-causal explanation for the fluctuations in at least three key variables. The results are likely to be controversial, because: (i) partial-equilibrium, habit-formation models do a better job in predicting the relative volatility of the current account (Gruber 2004; but see Kano 2003); (ii) shocks to world interest rates matter significantly in other carefully calibrated equilibrium models (Nason and Rogers 2003); and (iii) how the model is closed seems to matter dramatically for short-term current account dynamics, and this is in sharp contrast to the models examined by Schmitt-Grohé and Uribe (2003). Overall, the findings are remarkable.

2. Boileau and Normandin refer to these as "productivity" shocks. However, in their model economy, these shocks represent exogenous and unexpected changes in total factor productivity or technology. Consequently, throughout this discussion, I label them as "technology" shocks.

Table 1
Framework and findings

Interest differential depends on	Preferences	
	Isoelastic	Habit formation
Net foreign assets (NFAs)	Preferred	Poor
NFA-GDP ratio	Poor	Not simulated
Shocks		
Technology (preferred)	World interest rate	Government spending

Interpretation of the Results and Reservations

To highlight the economic significance of the results, let me sketch the main mechanisms related to consumption and the current account embedded in the model. First, as in the present-value model of the current account, there is the consumption-smoothing motive over time and across states. There are only two assets: physical capital and a risk-free bond (markets are incomplete). The novel feature here is the consumption-tilting motive because of the variable interest rate. The main contribution of the paper can thus be defined by two related objectives: (i) to determine whether the consumption-tilting motive is sufficiently important to account for Canadian current account movements; and (ii) to determine whether the variable interest rate is due to world or country-specific shocks.

With isoelastic utility and income uncertainty, there is no known analytic solution for the consumption function and current account. So, to isolate the key issues, let consumption (C) growth be log-normally distributed. Then, the following approximation holds:

$$E_t[\log(C_{t+1}/C_t)] \approx \sigma(r_t - \rho) + \frac{\operatorname{var}\Delta C_{t+1}}{2\sigma}, \tag{1}$$

where r_t is the one-period interest rate payable in period $t+1$, ρ is the discount rate, σ is the elasticity of intertemporal substitution, and $\operatorname{var}\Delta C_{t+1}$ is the conditional variance of consumption growth, $\log C_{t+1}/C_t$. Consumption growth, and by implication, the current account, depend on the interaction between the elasticity of substitution and the real interest rate. In general equilibrium, r is endogenous. Consequently, any desire to tilt consumption over time will have an immediate impact on the interest rate, and vice versa.

Next, the authors link the Canadian interest rate to the world interest rate (r^w) plus a risk premium (or interest differential, D), which is a decreasing function of Canadian net foreign assets, B:

$$r = r^{w} + D(B). \tag{2}$$

Finally, the domestic interest rate must be equal to the marginal-value product of capital $F_K(K, ZL)$, net of rate of depreciation (δ):

$$r = F_K(K, ZL) - \delta, \tag{3}$$

where Z is the level of labour-augmenting technology, which the authors consider stochastic, and K and L are capital and labour services, respectively.

Competing shocks

Equations (1) to (3) suggest that in this model a positive transitory technology shock resembles a negative world interest rate shock. In both cases, keeping capital stock constant, consumption initially increases because of an intertemporal substitution motive and then reaches its steady-state value from above (equation (1)). At the same time, the country accumulates capital and runs transitory current account deficits. This in turn leads to a higher level of foreign liabilities, and thus a higher risk premium. There is only one consumption-tilting mechanism that is not shared by responses to both shocks. This is the initial endogenous response of the domestic interest rate to technology shocks resulting from a change in the marginal-value product of capital (equation (3)).

This raises the question of how one discriminates between the relative importance of world interest rate shocks and country-specific technology shocks. The authors tend to side with the technology-shock interpretation, because these shocks generate more "realistic" current account movements. I have several concerns, however. First, very little of the output dynamics are endogenous to the model (Cogley and Nason 1995). Across the three calibrated models, the dynamic-impulse response of output to technology shocks is virtually indistinguishable (see Boileau and Normandin's Figure 1, column 1). The basic weakness of internal-propagation mechanisms is also evident in the dynamic responses to the other two shocks considered. Since the estimated volatility and persistence in government spending and interest rate shocks are small relative to technology shocks, none of the policy shocks generates interesting dynamics.

A second concern is that, by setting the pre-shock level of Canadian net foreign assets to zero, the authors essentially rule out potentially significant wealth effects resulting from world interest rate shocks. This raises the possibility that world interest rate shocks are not given a fair opportunity in this "horse race." Third, their inference techniques do not allow for the

simultaneous influence of multiple shocks, which is the more realistic scenario.

Also note that the current account and interest differential exhibit vastly different impulse responses to technology shocks. This is important in ruling out preferences with habit formation and the model in which the interest differential depends on the NFA-GDP ratio. Yet, the three models exhibit visually identical impulse responses of the current account and interest differentials to government and interest rate shocks. This has a perplexing implication that modelling details are inconsequential in understanding the impact of policy shocks, but not technology shocks, in the context of small open economies.

Identifiable shocks

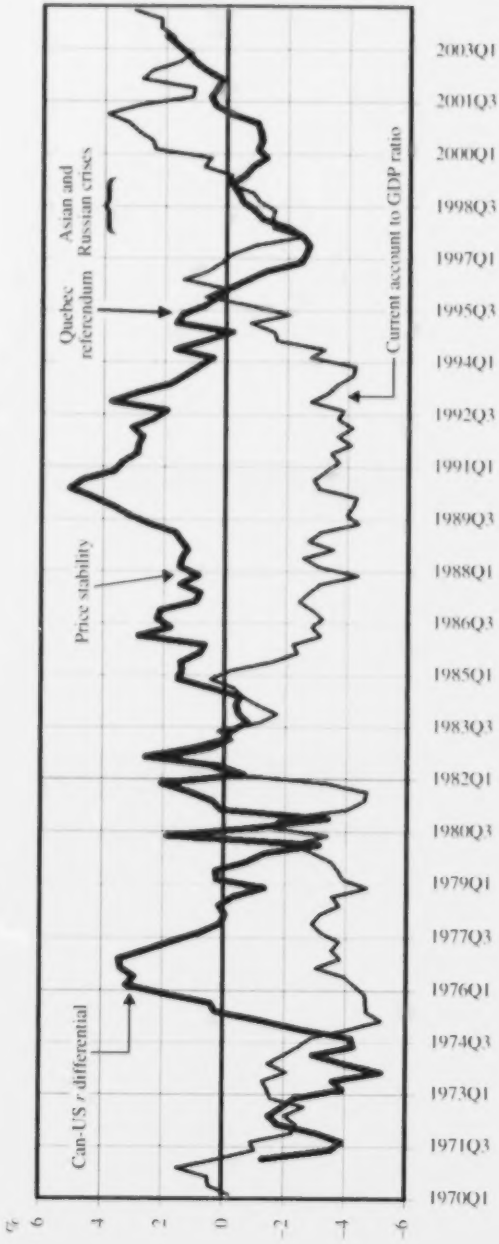
Are technology shocks really much more significant relative to policy, terms-of-trade, and nominal shocks? Skeptics point out that, if these technology shocks were so important *and* frequent, we would have heard about them. These concerns are legitimate. Moreover, we *do* often hear about swift changes in monetary and fiscal policy, as well as sudden stops in financial capital inflows.

Indeed, interest rate differentials appear to respond to identifiable changes in policy stance and to external shocks. Figure 1 labels three such identifiable, large shocks: the announcement by Bank of Canada Governor John Crow of "price stability" as the primary objective of monetary policy in Canada (1988Q1); the run-up to the Quebec referendum (1995Q3); and the Asian and Russian crises and the concomitant "flight to quality" (1997Q2–1998Q3).[3] The reader can easily think of other disturbances, both domestic and global, that have influenced interest differentials. Note that, by contrast, the current account seems to be driven much less by sudden policy reversals or even external shocks.

A technology-shock-driven explanation of the risk premium has a dramatically different interpretation, which I think is counterintuitive: a country-specific, positive technology shock stimulates investment and foreign borrowing, which in turn increases the interest differential, *D*.

3. All data are quarterly and seasonally adjusted (except interest rates) on an annualized basis, and are obtained from CANSIM II. To calculate the real interest differential, I (unrealistically) endowed agents with perfect foresight. One would like to use survey forecasts, but unfortunately, these are not available for the entire sample period. Specifically, I used the 91-day treasury bill rate for the Canadian dollar and the three-month LIBOR for US-dollar interest rates. To calculate inflation rates, I used the actual year-over-year change in CPI, all goods.

Figure 1
Current account and real interest differential



However, it is difficult to think of a higher interest premium as a sign of "good news," as the model of Boileau and Normandin would have us believe.

As well, the emphasis on technology shocks and frictionless equilibrium in accounting for the link between the Canadian current account and the real interest rate differential in the short run potentially overlooks important issues. In particular, Canadian data seem an exciting choice to examine this link in the medium run when adjustment to large and identifiable shocks is rather "sluggish." Figure 1 shows that there are notable medium-term swings in the current account (normalized by GDP), and some of these swings are closely associated with the "dance" of the real interest rate differential. The movements in the two series are fairly synchronized in the early 1980s and throughout the second half of the 1990s, when an increase in the Canadian interest rate relative to its US-dollar counterpart is associated with improvement in the current account. One would have expected a slightly different correlation from a Mundell-Fleming model and the standard elasticity approach (rising interest rate differentials, appreciation of the Canadian dollar relative to the US dollar, and an increase in current account deficits). By contrast, the rest of the period (especially from 1985 to 1995) seems to concur well with the conventional story, whereby a positive interest rate differential is associated with deterioration in the current account. Providing a coherent explanation for these medium-run movements is challenging. But, it would be interesting to see whether a frictionless general-equilibrium model can account for these correlations without falling back onto mysteriously large aggregate technology shocks.

Determinants of the risk premium

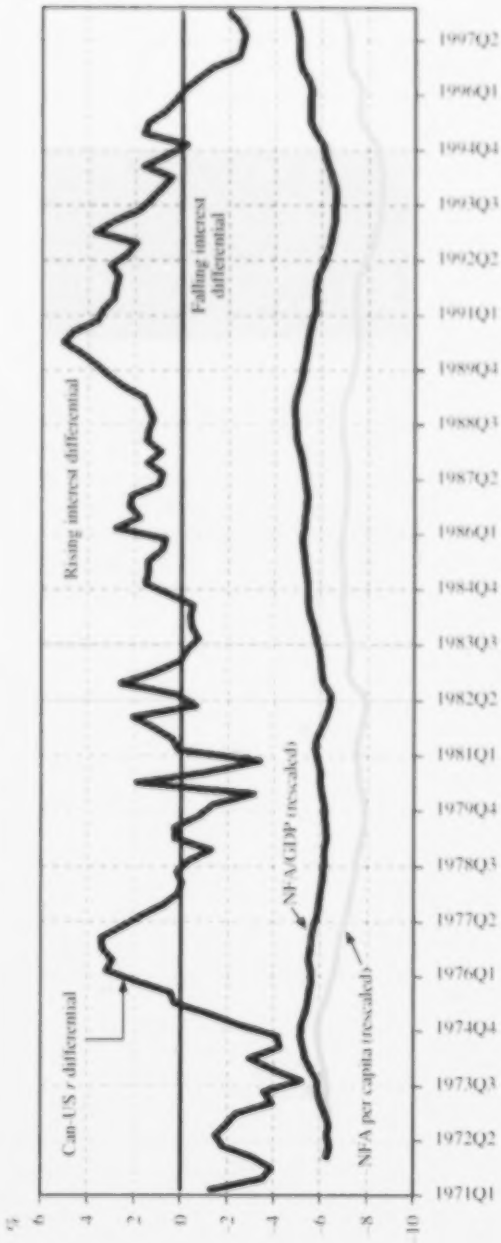
The second aspect of the Boileau-Normandin model is the proximate determinants of the real interest rate differential. They consider the following specification:

$$D = -\varphi B / Y^{\xi} \quad \text{with} \quad \varphi \geq 0, \ \xi \geq 0. \tag{4}$$

For $\xi > 0$, the interest rate differential depends on the net foreign asset to GDP (Y) ratio. For $\xi = 0$, only the size of net foreign assets matters for the interest rate spread. The data simulated from these alternative theoretical models suggest that the specification with $\xi = 0$ matches the moments of the actual data "better."

This finding is surprising, because the raw data do not seem to discriminate that well between the two alternatives. Figure 2 presents both NFAs to

Figure 2
Net foreign assets and real interest differential



output ratio and per capita NFA for Canada against the real interest differential. As expected, the stock values are much smoother. But note the high correlation between NFA-output ratio and per capita NFA: about 0.50 for the period 1971Q4–1997Q4 and 0.74 for the period 1975Q1–1997Q4, which corresponds to Boileau and Normandin's sample period.[4] Evidently, the simulated data from the theoretical models are considerably more discriminating about the precise specification of the interest rate differential (equation (4)). The raw correlations between per capita NFA and the interest rate differentials are more supportive of the view that links interest rate differential to net foreign assets, but the correlations are not particularly high, especially after the first oil shock (–0.048 for per capita the NFA versus –0.029 for NFA-GDP ratio).

What's Next?

At least three interesting observations follow directly from this paper:

- There is a growing consensus in the literature that the variable real interest rate is an important source of fluctuations in the current account, though there is considerable disagreement on the ultimate driver of the domestic interest rate.
- There is an urgent need for a better empirical understanding of the link between net foreign assets and interest rate differentials. There is, however, no guarantee that this relationship has been stable over time, especially during periods of domestic or global financial turmoil and fiscal extravaganza.
- There is active research on the optimizing models of the current account with emphasis on explaining its short-run fluctuations. However, there are strong empirical grounds to build tractable equilibrium models of the current account for the medium run with realistically calibrated frictions.

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General Discussion*

Takashi Kano agreed with Gregor Smith's comments on the need to study investment dynamics to understand current account fluctuations, though this would make the analysis more complicated. In response to Talan Iscan's comments on the distinction between the two net foreign asset measures in his paper, Michel Normandin pointed out that while there may not be much difference in the two measures, the model has different properties and generates quite different outcomes, depending on the measure chosen.

Lawrence Schembri was surprised at the strength of the rejection of the present-value model, given that it seems to track the data fairly well. Kano replied that in future research he wanted to look at the test statistics more carefully. David Johnson asked how fiscal policy fit into the Bouakez-Kano model, what its role was. He wondered about the absence of a government sector, since there is a lot of work showing that fiscal policy affects the current account. Hafedh Bouakez added that Michel Normandin has written a paper with an overlapping-generations model in which the government deficit has an effect because his model has finite-lived agents. Their paper, on the other hand, can't explain fiscal policy effects because they use an infinite-horizon model, and Ricardian equivalence holds. Thus, it does not matter how the government finances the public deficit.

Andrew Rose remarked that Normandin's claim that his baseline model fits the data "remarkably well" was contradicted by the large discrepancies reported in Table 1. Normandin replied that when you look at the means, the model performs quite well, but perhaps they should have said that their preferred model fits the data "better."

* Prepared by Robert Lafrance.

Session 4:
Real Linkages: Canada and the Rest of the World

Growth and Integration: The Emergence of China and India and the Implications for Canada

*Brigitte Desroches, Michael Francis, and François Painchaud**

Introduction

During the past two decades, India and China have experienced rapid economic expansion that has taken them from poor agricultural economies to countries that compete not only with other emerging-market economies but also with industrialized economies. While this accomplishment is broadly consistent with the predictions of the neo-classical convergence literature, it is nevertheless remarkable, because, as Pritchett (1997) noted, divergence and not convergence in per capita incomes across countries is the norm. Within this context, we address the following questions: What has caused China and India to successfully depart from the historical economic backwardness associated with poor countries? Is this growth sustainable? What are the implications for Canada?

There has been an extensive debate in the literature about the underlying factors supporting convergence among some developing economies and the economic success of industrialized countries. Acemoglu, Johnson, and Robinson (2001) and Easterly and Levine (2001), among others, have

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suggested that the strength of institutions lays the foundation for strong and sustainable economic activity.

Concomitantly, openness to trade is associated with the rich industrialized countries and with successful developing countries, especially the Asian "tiger economies." Thus, many authors, such as Frankel and Romer (1999), have concluded that openness to trade has, in itself, a large and beneficial impact on income. More recently, however, authors such as Rodrik, Subramanian, and Trebbi (2002) have questioned this result, arguing that institutions, not trade, are the source of growth. Rigobon and Rodrik (2004) and Yanikkaya (2003) even find evidence to suggest that trade contributes negatively to growth.

There is, therefore, no agreement as to whether trade is conducive to growth. However, this should not preclude a well-defined relationship between trade and growth. An extensive theoretical literature (see Findlay 1995, for example) suggests that factor accumulation is strongly influenced by trade and the long-run determinants of comparative advantage.

In this paper, we attempt to address this issue by positing that institutions influence growth directly and also indirectly by serving as a long-run determinant of comparative advantage.[1] To this end, we present empirical results supported by a theoretical model to provide evidence that trade does have an important effect on growth, but that this effect is non-linear and determined by the interaction of trade with institutional quality.[2] In particular, we find evidence that trade liberalization can reinforce the process of capital accumulation and growth in countries that have high-quality institutions, and reduce the incentives for capital accumulation and growth in countries with weak institutions. In that context, differences in institutional quality can induce specialization and trade consistent with divergences in long-run income levels. On the other hand, we find that the benefits of institutional reform are magnified in countries that are relatively open. We therefore argue that the impact of China and India's emergence in the world economy depends on both the process of trade liberalization and institutional reform.

Our research is also part of another strand of literature that has sought to relate the pattern of trade to the level of development. Garnaut (cited in

1. This view is consistent with the new and growing literature linking institutional quality and financial development (as in La Porta et al. 1998, for example) and financial development and comparative advantage (Beck 2002).

2. In this respect, our research is related to new work by Calderón, Loayza, and Schmidt-Hebbel (2004), who find a non-linear relationship between growth and trade, conditional on the level of per capita GDP.

Bhagwati 1999) has shown that the importance of China's exports of labour-intensive manufactures has risen dramatically since 1980, but it has simultaneously and symmetrically fallen in other East Asian economies. This changing pattern of trade in East Asia suggests that China's decision to integrate into the world economy has forced other East Asian economies to specialize in products with higher value added, or to step up the "ladder of comparative advantage," as Bhagwati refers to it.

Somewhat independently, other authors (such as Kwan 2002 and Rose 1997) have noted that East Asian economies behave like "geese flying in formation," suggesting that there is a well-defined relationship between their trade and their level of economic development. By extending Kwan's analysis, we find a clear relationship between a country's position on the ladder of comparative advantage and the quality of institutions in that country, thereby supporting our view that institutions affect growth in part through determining long-run comparative advantage. We argue, therefore, that China's rise in terms of the sophistication of the goods it exports can be explained by its institutional reforms that have encouraged investment and market activity.

It follows, therefore, that institutional reform and trade liberalization in China and India may be affecting the rest of the global economy. China especially is now a large trading nation. We find that the process of growth and trade liberalization in China has had a positive impact on the rate of growth in Canada. This occurs because, in our reading of the evidence, although China is increasingly stepping up the ladder of comparative advantage and competing with Canada in the production of some goods, Canada is responding by becoming increasingly specialized in the production of relatively sophisticated products. This process encourages capital accumulation and growth.

The rest of our paper is structured as follows. Section 1 presents a theoretical framework linking economic growth to institutional quality and trade openness. Under this framework, trade affects growth in a non-linear fashion through its interaction with institutional quality. This non-linearity has been overlooked in the literature. We find empirical support for this theoretical framework in section 2, and in section 3, we look at the process of reform in China and India and examine the impact on growth and the pattern of trade. We consider the impact on Canada in section 4 and offer concluding thoughts in the final section.

1 The Theory

Since we are concerned with the long-term implications of the integration and growth of the economies of China and India, we use a neo-classical trade and growth framework consistent with Manning (1981); Manning, Markusen, and Melvin (1993); Baxter (1992); and Findlay (1995). This theoretical framework is known in the literature as the Findlay-Komiya (FK) model (Brecher, Chen, and Choudhri 2002).[3] It combines a Ramsey neo-classical model of optimal savings with the Heckscher-Ohlin (HO) trade model.

In the FK model, an economy's comparative advantage reflects factors affecting the willingness to accumulate capital, not factor abundance, as in the HO model. For example, in Baxter's version of the model, a subsidy to the capital-intensive sector raises the return to capital and induces capital accumulation. Following the (Tadeusz) Rybczynski theorem, this process results in an expansion of the capital-intensive sector and a contraction of the labour-intensive sector. In a closed economy, the extent of capital accumulation is constrained by the domestic demand for the capital-intensive good. Essentially, the expansion of the capital-intensive sector continues until the relative price of the good falls sufficiently to offset the subsidy. In an open economy, however, this process continues until production is completely specialized or an adjustment in world relative prices constrains complete specialization. Therefore, under trade, policies positively affecting the willingness to accumulate capital (relative to those in other countries) can lead to higher levels of per capita GDP. However, as per the theory of the second best, trade can also exacerbate problems that inhibit growth, leading to lower levels of per capita GDP.

Consistent with the recent literature, we posit that, by protecting property rights and by solving common property, collective action, time inconsistency, and agency problems, good institutions encourage capital accumulation by raising the return to capital. Within the FK theoretical framework, differences in institutional quality across economies can create a divergence in the return to capital and per capita income in closed economies. Hence, good institutions can encourage growth, and the effect is magnified by trade. When an economy is open, specialization induces an increase in the demand for capital in the country with good institutions and a reduction in the country with poor institutions, reflecting the fact that countries with relatively good institutions tend to have a long-run comparative advantage in the production of capital-intensive goods, while countries with relatively weak institutions tend to have a comparative

3. Other related work includes Ventura (1997).

advantage in the production of relatively labour-intensive goods. This gives rise to a central theme of this paper: institutions, growth, and trade are closely linked, with trade inducing stronger growth in countries with good institutions and weaker growth in countries with relatively poor institutions.

2 Empirics

The theory presented in the previous section has two striking features. First, differences in institutional quality across countries influence comparative advantages and trade patterns. Second, trade affects growth through its interaction with institutional quality. This section examines the empirical evidence supporting these theoretical results. Particular attention is given to the non-linear impact of trade on growth, since it has been overlooked in the literature.

2.1 Institutional quality and patterns of trade

To assess the impact of institutional quality on trade patterns, we construct an index designed to rank countries according to their position on the ladder of comparative advantage and relate this measure to institutional quality. The first step in this brief analysis is to create for each three-digit SITC (Standard International Trade Classification) code, what Kwan (2002) refers to as a product sophistication index (PSI). This index measures, for each classification, the exporting country's expected per capita GDP. For example, handicrafts tend to be exported by countries with low levels of GDP and hence have low PSI numbers, while high-tech medical equipment is generally exported by countries with high income levels and hence have a high PSI numbers.[4] Having calculated this number for each commodity, we then calculate for each country an export sophistication index (ESI), which is the mean PSI value of its exports. Appendix 1 lists the ranking for 115 countries.

Figures 1a and b show scatter plots of ESI numbers for India, China, and Canada, using 2001 data, against various measures of institutional quality (political risk, and law and order) as reported in the International Country Risk Guide (ICRG) over the years 1996–2001.[5] The results show a clear relationship between institutional quality and the level of sophistication of a

4. In 2001, for example, the PSI for passenger motor vehicles was $26,131, while for natural rubber and latex, the PSI was $5,754 (in constant 1985 dollars, adjusted for purchasing-power parity).

5. In ICRG published monthly data, we have observations for the month of January only, so have chosen to use a five-year average to account for some of the noise that may be apparent in single observations.

Figure 1a
ESI vs. political risk index

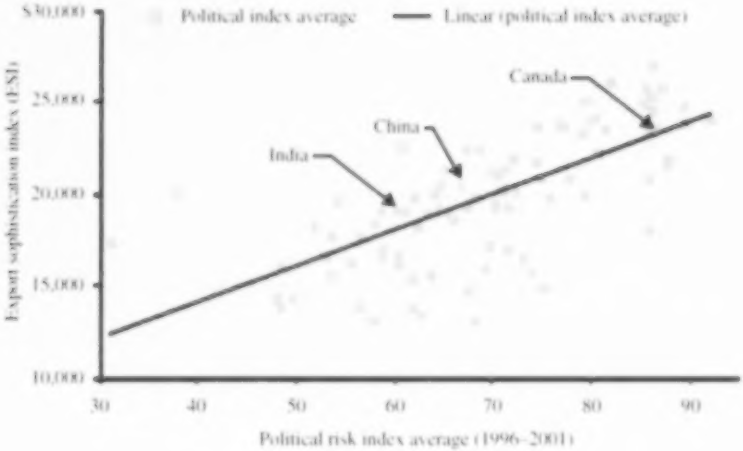
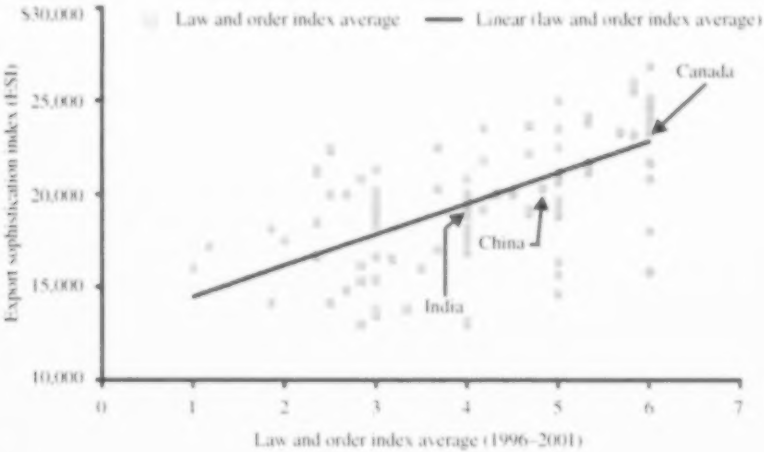


Figure 1b
ESI vs. law and order index average



country's exports. While such findings fall short of a formal test of our framework, they certainly suggest that institutions have an impact on trade patterns, and may also have an added impact on growth through their interaction with trade. The latter is the subject of our next section.

2.2 The interaction between institutions and trade, and the impact on growth

To examine the impact on growth, we turn to the literature on empirical growth. Traditionally, this literature has posited a linear relationship between growth and its determinants, such as trade openness and institutional quality. A common specification may take the following form:

$$\Delta y_{i,t} = \alpha_i + (\beta_0 - 1)y_{i,t-1} + \beta_1 X_{1i,t} + \beta_2 X_{2i,t} + \beta_3 X_{3i,t} + u_{i,t}, \quad (1)$$

where $y_{i,t}$ is (log) real per capita GDP in country i, α_i is a country-specific constant, $X_{1i,t}$ is a vector of country-specific explanatory variables, $X_{2i,t}$ is a measure of institutional quality in i, and $X_{3i,t}$ is a measure of i's openness at time t. Empirically, to take into account that an economy is growing towards its steady-state level, the lagged value of $y_{i,t}$ is also included. Lastly, u_i is an unobserved error term.

According to the theory presented in the previous section, however, the effect of trade also depends on the level of institutional quality, such that the degree of openness generates higher growth when trade occurs in an environment where institutions are better. This can be easily incorporated in equation (1) by assuming that $\beta_3 = (\gamma_1 + \gamma_2 X_2)$:

$$\Delta y_{i,t} = \alpha_i + \eta_t + (\beta_0 - 1)y_{i,t-1} + \beta_1 X_{1i,t} + \beta_2 X_{2i,t} + \gamma_1 X_{3i,t}$$
$$+ \gamma_2 X_{2i,t} * X_{3i,t} + \mu_{i,t}. \quad (2)$$

We control for determinants of growth, other than institutions and openness. Real per capita GDP represents initial conditions (state variable). As such, this variable is measured at the beginning of each five-year period. Other explanatory variables (X_1) include investment as a share of GDP, share of government consumption in GDP, and the rate of inflation. These variables are measured as averages over five-year periods and represent the control variables.[6] The unobservable country-specific effects, α_i, are designed to capture the determinants of a country's steady state that do not vary over time and that are not already contained in the other explanatory variables.

6. For sources and definitions of the variables and the list of countries used in growth regressions, see Appendixes 2 and 3, respectively.

The methodology allows us to estimate the coefficients without having to restrict the individual effects to being either fixed or random. The time-specific effect, η_t, captures the effects of global shocks on economic growth common to all countries.

A weak-form test of our theoretical framework would be whether $\beta_3 > 0$. That is, the impact of trade is always positive $(\gamma_1 > 0)$, but having better institutions (greater value for X_2) results in an even more positive impact of trade on growth $(\gamma_2 > 0)$. A strong-form test of our theoretical framework translates into a positive impact of trade on growth $(\beta_3 > 0)$ when institutions are good, but negative $(\beta_3 < 0)$ when institutions are weak (alternatively, a negative direct impact of trade on growth $(\gamma_1 < 0)$ and a positive contribution from trade through the interaction variable $(\gamma_2 > 0)$).[7]

A negative coefficient for the state variable would be consistent with the prediction of the neo-classical growth model as it represents the convergence effect. The coefficients on government consumption and the inflation rate are expected to be negative.[8] The effect of the other control variables on growth is expected to be positive, with the possible exception of the openness variable if the strong form of our hypothesis holds.

We use a dynamic generalized method of moments (GMM) system estimator approach to estimate equation (2), following Arellano and Bond (1991) and Arellano and Bover (1995).[9] Briefly, the technique involves undertaking the following steps. First, the growth regression is expressed as a dynamic model in the level of real per capita GDP.[10] Second, we difference the regression equation in order to eliminate the country-specific effects.[11] Third, we instrument the explanatory variables using lagged values of the levels and differences of the original regressors and dependent variable. The latter step eliminates the potential inconsistency coming from the endogeneity of the explanatory variables, while differencing eliminates

7. In addition, $-(\gamma_1/\gamma_2) < \max(X_2)$, because X_2 is bounded.

8. Government consumption captures public expenditures that do not directly affect productivity but could distort private sector decisions.

9. The system estimator is preferred to the difference estimator when the regressors are close to an AR(1) process. This is especially pertinent for the estimation of growth equations.

10. The lagged dependent variables can be introduced to either fixed- or random-effects models.

11. By eliminating country-specific effects, we can no longer interpret the coefficient on the lagged level of per capita GDP as a convergence parameter. Convergence is generally accepted to be dependent on country-specific fixed effects, which are eliminated from our analysis. However, since convergence is not the topic of analysis, we do not concern ourselves with this problem.

the potential inconsistency resulting from the correlation between the unobserved country-specific effects and the explanatory variables.[12]

Our results from this procedure are reported in Table 1 (with *p*-values in parentheses). The first column reports the results for a specification using a measure of political risk as a proxy for institutional quality. The second specification uses a measure of law and order. In both cases, the interaction variable is defined as the product of trade openness and a measure of the quality of the legal system and property rights.[13] The specification tests do not reject the null hypothesis of correct specification, indicating that the instruments are valid and lending support to our estimation. Looking at the Hansen test of over-identifying restrictions, we cannot reject the null hypothesis that the over-identifying restrictions are valid. The null hypothesis of no first-order autocorrelation in the differenced residuals is rejected, but we do not reject the null hypothesis of no second-order autocorrelation. While the rejection of the latter would have implied inconsistent estimates, the rejection of no first-order autocorrelation does not imply that the estimates are inconsistent (see Arellano and Bond 1991).

The different variables are generally significant, and the signs of the coefficients are consistent with our priors. The coefficient associated with real per capita GDP is significantly negative in both regressions, confirming the conditional convergence hypothesis, a standard result in cross-country growth regressions. The coefficient for government expenditures is also negative and significant in both regressions, while the coefficient for capital formation is positive and highly significant. The results also suggest that institutions are important and contribute positively to growth.

The coefficient for trade openness is negative, while the interaction term is positive and highly significant. Given that the coefficient for trade openness is not significant, these results validate the weak-form test of our theoretical framework. Under this assumption, trade always has a positive impact on growth, but better institutions magnify the gains from trade. However, taking these preliminary results at face value, the point estimates appear to be broadly in line with the strong-form test of our theoretical framework. This suggests that the total impact of trade on growth is negative or positive, depending on the quality of institutions (Figure 2), implying that trade is beneficial only to countries with relatively high levels of institutional quality (such as Canada), which is not the case of India or China. However, the

12. See Bond (2002) for an accessible discussion of the GMM system estimation technique.

13. The decision to use different institutional variables in the direct and interaction terms was made to avoid problems of multicollinearity.

Table 1
Dynamic system estimator[a]
The interaction between institutions and trade

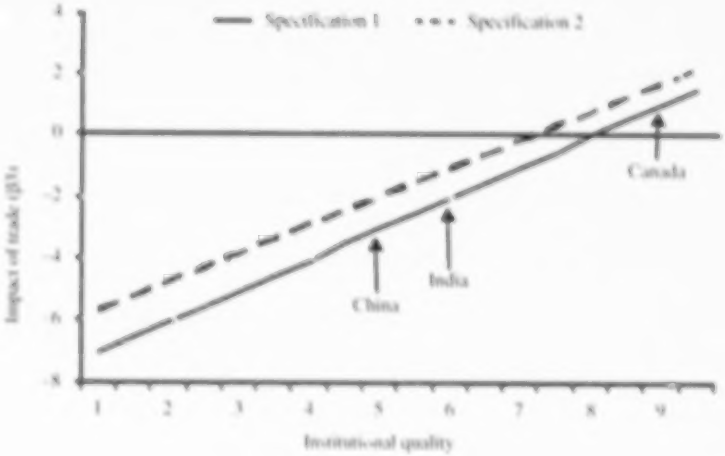
	Law and order	Political risk
GDP per capita	−3.823	−4.365
	(0.076)	(0.051)
Inflation	−0.262	−0.207
	(0.633)	(0.008)
Capital formation	27.791	26.149
	(0.000)	(0.000)
Government expenditure	18.308	−17.005
	(0.002)	(0.002)
Trade openness	8.107	6.607
	(0.104)	(0.136)
Institutional quality	3.542	−0.430
	(0.013)	(0.001)
Interaction term[b]	1.013	0.926
	(0.003)	(0.000)
Constant	1.990	−16.203
	(0.939)	(0.456)
Hansen test	0.310	0.430
AR(1) test for residuals	0.001	0.016
AR(2) test for residuals	0.121	0.100

a. Coefficients for time dummies and lagged dependent variable are not reported.
b. The interaction term is defined as the product of trade openness and the legal system and property rights score.

exclusion of China and India from the list of countries benefiting from trade openness may reflect the inherent measurement problems associated with measures of institutional quality. In particular, the recent reforms implemented in both countries, which will be discussed in the next section, may not be well captured by these institutional variables. Regardless, one clear result is that, having opened their economies in recent years, the future gains from institutional reform in India and China are likely to be magnified by trade.

The empirical analysis presented in this section is broadly consistent with our theoretical framework. First, our results suggest that institutional quality plays an important role in enhancing economic growth. Second, institutional quality also appears to influence the patterns of trade. These two findings are intrinsically linked. Institutional quality affects the pattern of comparative advantage across economies, and since countries accumulate production factors consistent with their comparative advantage, the quality of institutions also affects the rates of economic growth across different

Figure 2
The non-linear impact of trade on growth



economies. Third, our results indicate that trade could affect growth in a non-linear fashion through its interaction with institutional quality. This is a new, and in our view, important contribution to the literature on growth.

At this point, it is appropriate to add an important qualifier. Our analysis is purely positive. It does not make for a welfare analysis, and one cannot use our analysis to argue that trade liberalization will worsen economic welfare in a country with relatively weak institutions. Indeed, it may be a better allocation of resources to have investment taking place in countries with good institutions and to permit consumers in countries with poor institutions to consume a greater proportion of their income, thereby reducing the extent of any appropriation of their savings.

Nevertheless, in essence, these results suggest that emerging economies such as China and India, which have been improving their institutions, are reaping the benefits of past and present reforms, and the benefits are greater in more open economies. However, the impact of trade liberalization on these countries is unclear. To assess the potential impact on Canada, we need to investigate the reforms implemented in both countries and assess the prospects for further reforms. In the next section, we focus on China and India. We review their institutional reforms and examine the extent to which their growth is likely to be sustainable.

3 China and India

Having developed a general framework in which to analyze growth, trade, and the importance of institutions, we now examine China and India in detail to understand the extent to which the growth of these two economies can be sustained and the nature of the trade linkages between the two economies and the rest of the world. A review of institutional reforms is presented first, followed by trade reforms. This section also briefly discusses the relative position of China and India on the ladder of comparative advantage, and their economic prospects.

3.1 Institutional reforms in China

The first phase of the Chinese reform process occurred during the 1979–93 period. During that time, the authorities gradually decentralized the economic decision-making process. This resulted in fundamental changes in how goods and services were produced in China, but also in how the benefits of transactions were divided among economic agents. As such, these reforms, which will be discussed later, are interpreted as institutional in nature. They include the household responsibility system; reforms of the state-owned enterprises (SOEs) and the economic responsibility system; and the introduction of private sector enterprises and township and village enterprises (TVEs).

The household responsibility system (HRS) was introduced in 1979 to improve the efficiency of the Chinese agricultural system, which was burdened by production quotas and administered prices. Under the HRS, individuals could farm the communal land in exchange for a fixed production quota (effectively a lump-sum tax). Production in excess of the quota was allowed to be sold in the market, resulting in a remuneration system based on marginal productivity. This "dual-track" system introduced market-based incentives. By liberalizing agricultural production, prices, and wages in a predominantly agricultural economy, the HRS can certainly be interpreted as an institutional change. It resulted in a sharp improvement in labour productivity and a significant migration of labour out of the agricultural sector.[14]

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14. Employment in agriculture as a percentage of total employment fell dramatically, from around 70 per cent at the beginning the reforms, to about 50 per cent more recently. Despite this large reallocation of labour, there are still 150 million excess workers in the agricultural sector, according to Brooks and Tao (2003). Furthermore, Heytens and Zebregs (2003) have found that the reallocation of labour was pivotal to high growth. Woo (1998) and Young (2000) have also noted the importance of labour migration.

In an effort to absorb the excess labour coming from the agricultural sector, the Chinese authorities introduced a number of reforms to improve the allocation of resources in the industrial sector. The authorities successfully promoted the growth of the non-state sector, including TVEs.[15] They also increased the autonomy of SOEs with regard to production, supply, marketing, the use of retained profits, experimentation with new products, and capital investment (Chow 2002). In addition, the economic responsibility system (ERS) allowed SOEs to remunerate workers based on their level of productivity. Finally, the dual-track pricing system was broadened to incorporate industrial goods. By transferring management decisions to business leaders, these reforms ensured a better allocation of resources and increased accountability and incentives to perform.

The second phase of the reform process (since 1994) is characterized by the implementation of policies strengthening the effectiveness of market forces. They include the reduction of preferential treatments to certain companies, the introduction of more transparent government accounting, the creation of a central monetary authority, the continued reforms of SOEs, the first stages of a social safety net, and addressing the issue of property rights and ownership (Qian 1999).

In an effort to formalize the gains achieved through previous reforms, Chinese authorities recognized the concept of private ownership and the rule of law in March 1999. Furthermore, on 14 March 2004, the authorities introduced a constitutional amendment affirming that "private property obtained legally shall not be violated." The amendment was explicitly designed to prevent state officials from appropriating private property. By increasing the political cost of returning to the old system, the entrenchment in the constitution serves as insurance and provides greater confidence in reforms. This development could have important implications for economic growth. Reducing the uncertainty surrounding ownership and property rights is pivotal in providing economic agents the incentives to save, and thus, to accumulate capital.

Prospects for further institutional reforms in China fall into three broad categories. First, financial sector reforms could provide substantial benefits in terms of a more efficient allocation of resources within the economy. In particular, the banking sector needs to be restructured, policy lending eliminated, and a credit culture developed. Second, reforms of SOEs,

15. Qian (1999) enumerates policies that promoted the emergence of the non-state sector: fiscal decentralization, the extension of the dual-track price system to manufactured goods, the legalization in 1984 of private enterprises employing more than eight people, the granting of permission for joint ventures between domestic and foreign investors, and the near-abolition of administrative regulations discriminating against rural enterprises.

presented earlier, have not been completely implemented. In fact, they were generally limited to smaller firms. The broadening and deepening of reforms of all SOEs could further improve the business environment. Third, China still lacks the organizational structure to support the new and evolving institutions. Without solid governing organizations to support them, institutions are likely to be weak in practice.

3.2 Institutional reforms in India

Compared with China, India's reform process was very modest and gradual, suggesting that introducing reforms in a democratic environment is much more difficult than in an authoritarian regime (Srinivasan 2003). Despite the relatively minor changes in policies introduced at the beginning of the 1980s, real GDP growth accelerated markedly, from an average of 3.5 per cent during the 1950–80 period to nearly 6.0 per cent in the 1980s. According to Rodrik and Subramanian (2004a), even these modest reforms indicated an attitudinal shift in government policies towards a more pro-business environment, spurring economic growth.

Before the reform process gathered momentum in 1991, following a balance-of-payments crisis, meeting the objectives stipulated in the government planning exercises meant pervasive government regulations. In particular, rules and regulations were established to ensure that economic resources (domestic capital and foreign exchange) were allocated towards government-sanctioned investment opportunities, regardless of profitability. To a large extent, the tentative industrial reforms of the 1990s were aimed at reducing these inefficiencies, which were symbolized by industrial licensing and reservation.

Industrial licensing can be viewed as the counterpart in India to the rules and regulations burdening SOEs in China. Under this policy, the state regulated inputs in the production process, including investment projects, but also the location of plants and their expansion, and the technology used by enterprises (Srinivasan 2002). Licensing requirements were virtually eliminated in July 1991, except in industries where there are environmental, safety, and strategic concerns. By curbing excessive regulation, the authorities improved the business environment and lowered barriers to entry, and hence improved the institutional environment that supports investment.[16]

16. As noted by Srinivasan (2003), the fact that all the regulations were generally ad hoc rather than rule-based, implied a chaotic incentive structure and an environment conducive to rent-seeking behaviour and political corruption.

Industrial reservation encompasses two major sets of policies. First, certain industrial sectors were deemed strategic, and as such, their development was reserved to the public sector. Restrictions were eased in 1991, and private involvement was allowed in certain sectors such as power and telecommunications. While these reforms meant potential increases in competition, very little was changed in terms of the management of Indian SOEs. As in China, reducing the government's direct involvement in economic activity through privatization met with strong resistance. This is especially relevant in a democracy.

Second, reservation also applied to certain manufactured goods for exclusive production by small-scale industries (SSIs). As of 2002, almost 800 items were reserved for production by these firms, although larger firms can produce SSI items if they export more than 50 per cent of their production. Very little progress has been achieved in abolishing or limiting the impact of this policy. This is crucial, given that approximately 40 per cent of India's total manufacturing output and 35 per cent of its exports fall under this regulation. A more detailed discussion of SSI and its implications under trade liberalization is provided in section 3.3, which focuses on trade reforms.

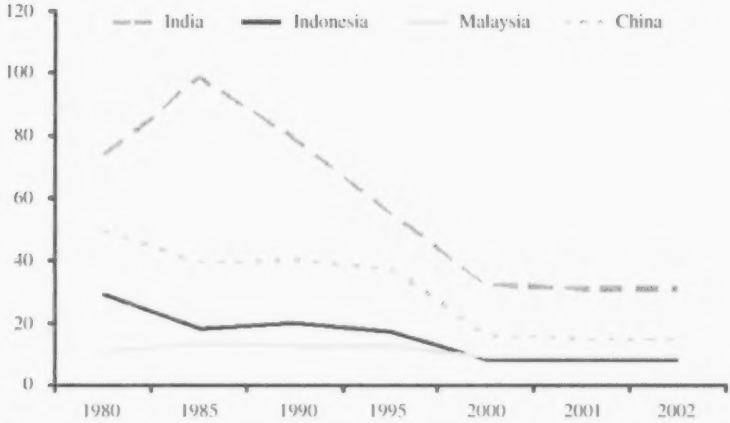
Other reforms could be implemented to improve the economic prospects of India. In particular, the bankruptcy and labour laws are quite restrictive, and their application is somewhat ad hoc. As an example, firms with more than 100 employees need the permission of the government to close down, even if the enterprises are not profitable. Federal-provincial fiscal interactions, public finances, and improving the state of the banking sector are also areas of future reforms.

3.3 Trade reforms in China and India

Given their similar import-substitution policy, both China and India were fairly closed economies before they started implementing trade reforms. In both cases, control mechanisms, such as prohibitive tariffs, quantitative restrictions, and import licensing, were leading to significantly reduced external trade possibilities (Lardy 2002; Srinivasan 2003).

In 1978, Deng Xiaoping's open-door policy promoted the opening of China to foreign imports and encouraged the development of the export-oriented sector. Tariffs, quotas, and licences needed to import and export fell considerably over the subsequent years, especially in 1992 and 1996

Figure 3
Tariff index



Source: The Fraser Institute.

(Figure 3).[17] However, in order to have a competitive tariff structure compared to other countries in the region, China must implement additional measures for trade liberalization.

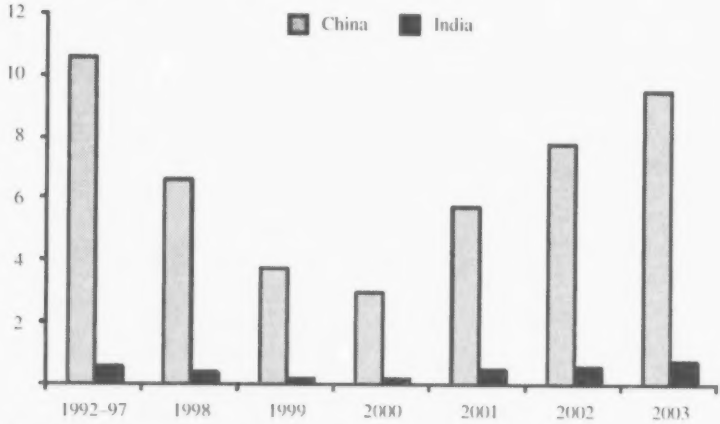
Another policy that greatly improved external trade in China was the creation of open economic zones (OEZs) in 1982. They were established in an effort to attract foreign direct investment (FDI) as well as to promote exports.[18] Within these zones, investors could establish factories to take advantage of preferential tax and administrative treatment (duty-free imports to produce exports), collaborate with foreign companies (investment, manufacturing, and distribution), obtain market-based remuneration for employees, and avoid prohibitive taxation by the state (Démurger et al. 2002).[19] While there was a significant slowdown in FDI during the Asian

17. An analysis of the implementation of trade reforms reveals that trade policy was mainly concerned with the protection of high-value industry and high-tech industry and the need to protect financially vulnerable industries (Chen and Feng 2000).

18. Zebregs (2003) estimated that FDI contributed directly 0.4 percentage points to annual GDP growth during the 1990s (through capital deepening). This pales in comparison to its indirect contribution, which is estimated to be 2.5 percentage points.

19. India introduced the concept of OEZs before China. However, Indian authorities did not provide incentives, except for access to duty-free imports. Firms establishing in these zones had to face the same pervasive rules and regulations as in the rest of India. The attempt failed.

Figure 4
FDI inflows (percentage of total)



Source: *World Investment Report*, United Nations.

crisis, FDI has rebounded markedly in China (Figure 4). In 2003, China attracted around 10 per cent of world FDI, compared to less than 1.0 per cent for India. The large difference between China and India suggests that foreign investors perceive China as a much more business-friendly environment.

Further reforms are forthcoming under the World Trade Organization (WTO) commitments that China made in 2002. In particular, additional reductions in tariffs and quotas are expected. China is also committed to opening its service industry, including the banking sector. This could mitigate some of the risks associated with the current state of this sector.

India has also made efforts to reduce tariffs and quotas after its balance-of-payments crisis in 1991. The mean tariff rate decreased from almost 100 per cent in 1980 to around 30 per cent in 2001–02. While tariffs have fallen considerably, they are still relatively high compared to other nations in the region. For example, China's mean tariff was 15.3 per cent in 2002, while the mean tariff in Indonesia and Malaysia was about 8–9 per cent.

The inability of India to reduce its tariffs may reflect political-economy factors. In particular, the existence of SSI reservation limits the development of certain industries. The implication of the SSI reservation is that domestic firms may have to operate below their optimal (unconstrained) level of production, translating into inefficiencies and higher output prices. In that

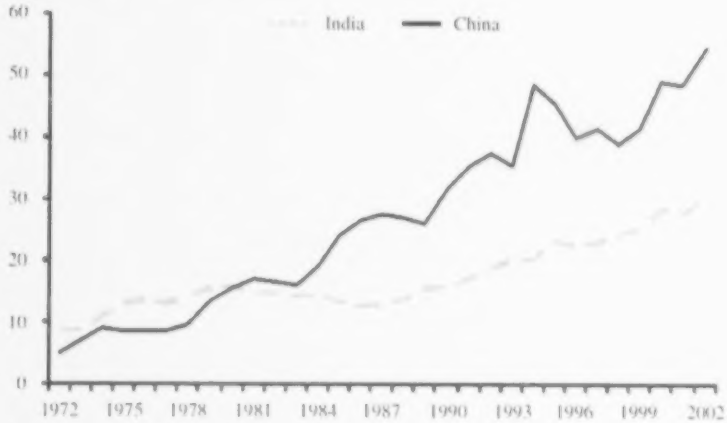
context, foreign firms, unconstrained by SSI, have a considerable advantage. As a result, by lowering tariffs on these products, trade liberalization may reduce the output price below what is necessary for domestic firms to operate, thereby inducing an exit from the industry (if the government permits). Consequently, even if India has a comparative advantage in certain industries, trade liberalization, without the alleviation of SSI reservation, may result in a contraction of these industries, rather than an expansion. This is consistent with our theoretical framework and our empirical results—weak institutions are detrimental to economic prospects directly, but also indirectly through interactions with trade. Essentially, high tariffs in India may reflect the impact of government-induced inefficiencies in certain industrial sectors. This is also evidenced by India's regular use of anti-dumping measures within the WTO structure.

Not surprisingly, the impact of trade liberalization was more important in China than in India. As shown in Figure 5, China's measure of trade openness increased dramatically, from 5 per cent of GDP in 1972 to 55 per cent in 2002. For India, openness increased from 9 per cent of GDP in 1970 to 31 per cent in 2001. That said, the trade performance of both countries was generally better than that of the rest of the world, resulting in an increase in the importance of India and China in world trade (Figures 6 and 7).

The lacklustre performance of India compared to China is also captured by the coefficients on country dummy variables estimated in a gravity trade equation (Figure 8).[20] A positive country dummy illustrates a high propensity for trade for that country compared to the rest of the world (after controlling for other determinants of trade). The equations were estimated for a large cross-section of countries for each year from 1985 to 1999. The coefficients reveal that over the period of estimation, China, South East Asia, and industrialized nations are "over-traders," while India's trade is average. That is, India's trade is similar to that of all other developing countries as a group, excluding the Asian tigers. Interestingly, while China's performance is remarkable, the results suggest that it is less of an over-achiever than other, albeit smaller, South East Asian economies. These estimates suggest that China has the potential to raise its trade performance even further. It is likely that this has occurred during the past four years, which were not included in the estimation period.

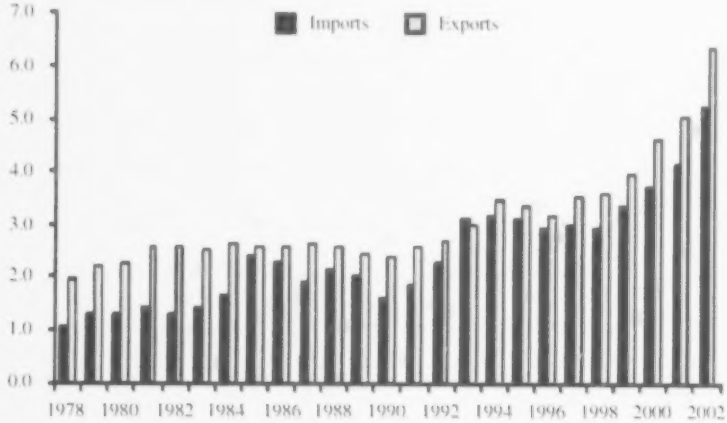
20. We used the Rose (2000) data set to estimate our gravity equations. Because we were interested in institutional quality, we augmented the equations with the law-and-order measure from ICRG. The results are available from the authors upon request.

Figure 5
Measure of openness, $(X + M)$/GDP



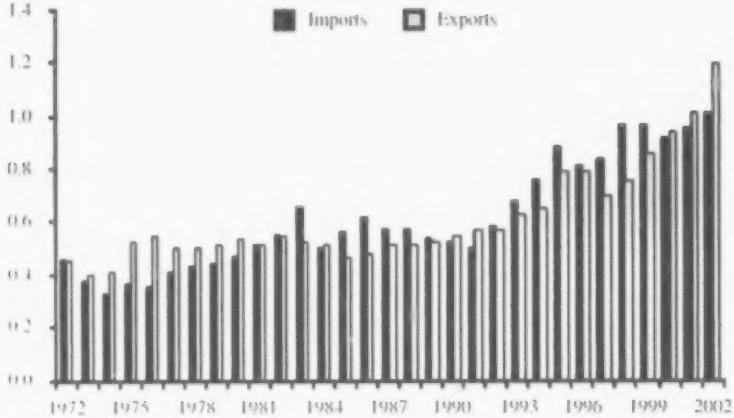
Source: World Bank.

Figure 6
China's share of world trade



Source: World Bank.

Figure 7
India's share of world trade



Source: World Bank.

Figure 8
Relative trade performance

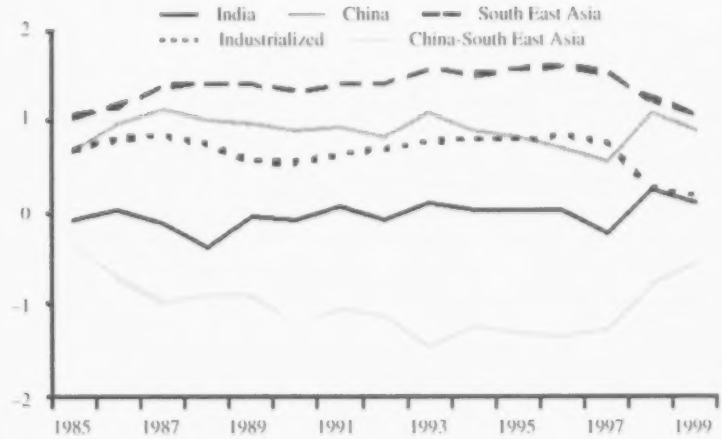


Figure 8 also illustrates the coefficient on a dummy for bilateral trade between China and the Asian tigers. It shows that once their propensity to over-trade is accounted for, bilateral trade between China and the Asian tigers is lower than with the rest of the world. This is understandable, to the extent that their economies are relatively similar. The results also reveal the impact of the Asian crisis, which saw a downturn in the over-performance of the South East Asian economies and a sharp upturn in the performances of India and China. The results suggest that the Asian crisis marked a change in the pattern of trade as the importance in trade of the industrialized countries was reduced, while China and India improved.

3.4 The ladder of comparative advantage and economic growth

The reform processes introduced by China and India have affected their relative positions on the ladder of comparative advantage. In 1985, with ESI scores of 14,376 and 14,383, India and China were effectively side by side on the ladder of comparative advantage, ranking 54 and 55, respectively. By 2001, however, China, with an ESI score of 20,468, had leapt to 41 on the ladder, surpassing India, which had slipped to 60 in the ranking, with an ESI score of 19,192.

Figures 9a, b, c, and d show a more detailed perspective of the evolution of the trade patterns of China and India. In 1985, their exports tended to overlap significantly, making them competitors in many areas. Over time, however, the share of exports with high PSIs increased significantly in China and to a lesser extent in India. This suggests that China's more rapid pace of economic expansion has resulted in a more rapid progression up the ladder of comparative advantage, compared to India.

This is consistent with our theoretical framework and our empirical analysis. Even when we abstract from the institutional changes discussed in detail above (which are not explicitly captured by institutional variables), China generally scored better on these measures (political risk, and law and order) than India (see Figures 1a and b). It is not surprising, therefore, that when market forces began to improve the allocation of resources in these economies, China's production structure moved towards more sophisticated goods and leap-frogged the Indian economy in the process.

These results suggest that improving institutions that support a market-based economy is important in shaping the comparative advantage of an economy. In addition to better institutions, China's more dramatic ascension may also reflect, in part, its greater openness, and hence its increased ability to specialize (especially if, as we allude to above, China's economic institutions had improved significantly more than our legal system and

Figure 9a
Share of exports ranked by PSI, India and China (1985)

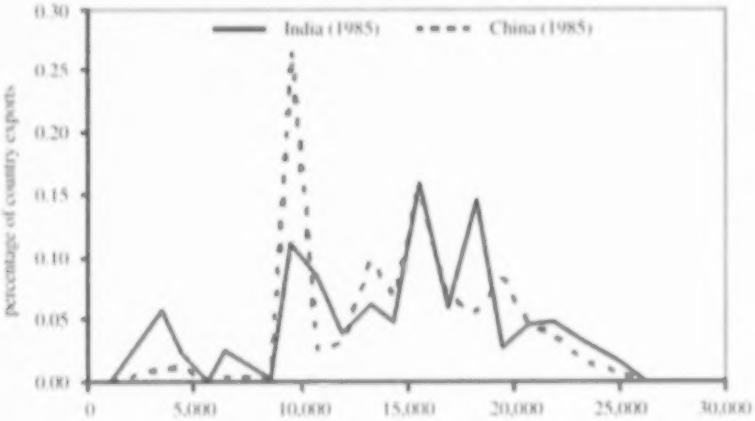


Figure 9b
Share of exports ranked by PSI, India and China (2001)

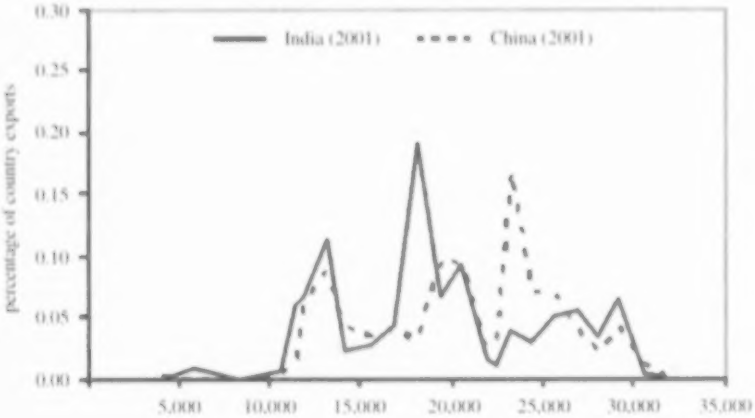


Figure 9c
China's changing pattern of exports

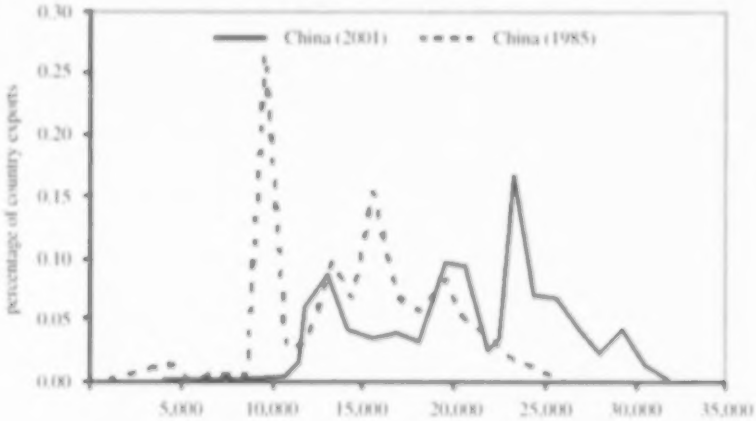
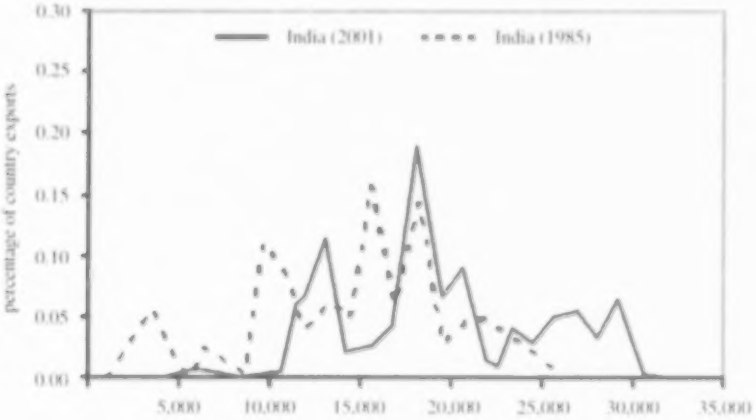


Figure 9d
India's changing pattern of exports 1985–2001



property rights measure would indicate). If this is true, then changes in comparative advantage should affect the process of factor accumulation and affect differently the growth processes in the two countries, a view supported by our empirical results.

4 The Implications for Canada

For Canada, the rapid growth rates and increasing openness in India and China have resulted in an increase in bilateral trade with Canada. Although it is difficult to estimate the contribution to Canadian growth from China or India's emergence without considerable qualification, our empirical results suggest that, with a score of 9.3 for the quality of its legal system and property rights, trade has been an engine of growth for Canada. For example, consider the impact of China on Canadian openness and growth. Over the period from 1997 to 2002, China's trade with Canada grew by approximately 109 per cent from US$6.1 billion to US$12.7 billion. Although this trade is relatively small compared to Canada's overall trade, its rapid growth nevertheless contributed approximately an extra 1 per cent to the value of the share of Canada's trade to GDP (from approximately 82 to 83 per cent of GDP). If one is prepared to throw caution to the wind and assume first, that the expansion in trade did not come at the expense of trade with Canada's other trading partners; and second, that our empirical estimates are robust; then, equation 2 suggests that this expansion in trade with China would produce a 1.9 per cent (= -6.6+0.026*9.3) growth premium spread out over five years (i.e., just under 0.4 per cent per year). This is a significant and positive result, although given the qualifications for its validity, we would not want to put much emphasis on the magnitude of this number.

4.1 Explaining Canada's trade-induced growth: Is there a "China effect"?

Over the period from 1985 to 2001, Canada's ESI rose from 20,062 to 23,745. Its ranking on the ladder slipped, however, from 10 to 16, losing ground to countries such as the Netherlands and Denmark. Nevertheless, an examination of the change in the distribution of Canada's exports (Figure 10a) suggests that Canadian exports have become more consolidated in high PSI goods at the expense of middle PSI goods. At the same time, however, comparing these to the distribution of exports of China and India (Figures 10b, c, d, and e), it is evident that Canada now faces considerably more competition from China in the middle PSI range. These graphs suggest that China's comparative advantage has changed over time with the result that

China is now competing directly with some of Canada's exports in the low to middle range of the distribution.[21]

Arguably, it is the increase in competition from China in less sophisticated products and the corresponding improvement in Canada's terms of trade that have encouraged Canadian exports to have become more consolidated in relatively more sophisticated goods. However, it could also be the case that during the period from 1985 to 2001, the composition of Canada's exports was affected by the process of bilateral trade liberalization with the United States. If Canada traditionally exported high PSI goods to the United States, for example, then it may simply be that the North American Free Trade Agreement (NAFTA) pressured Canadian exports to become more sophisticated. To address this issue, we break Canadian industry exports down into an industry effect and a destination effect using shift-share analysis.[22] Our hypothesis is that if the impact of NAFTA is driving our results, then Canada's consolidation in relatively high PSI goods will have been driven by a destination effect. On the other hand, if China's opening to the world is changing the relative prices of goods in favour of higher PSI goods, we should see the change in trade driven by industry-specific effects.

Mathematically, we write the net relative change (NRC) in Canadian industry i exports as follows:

$$NRC_i = \frac{\sum_d X^0_{i,d}(x_{i,d} - x)}{X^1_i},$$

which can be rewritten as:

$$NRC_i = \frac{\sum_d X^0_{i,d}(x_d - x) + \sum_d X^0_{i,d}(x_{i,d} - x_d)}{X^1_i}, \qquad (3)$$

where $X^0_{i,d}$ is the initial level of industry i exports to destination d; x_d is the growth rate of Canadian exports to destination d; $x_{i,d}$ is the growth rate in industry i exports to destination d; and x is the growth rate of Canadian exports between 1985 and 2001. X^1_i is the hypothetical level to which

21. Graphs illustrating the distribution of bilateral trade show a similar pattern between China and Canada, but a relatively unchanged pattern of trade between Canada and India. Graphs are available from the authors upon request. Appendix 4 provides details of the top 20 exports of China and India, as well as the top 20 bilateral exports and imports between China and Canada and between Canada and India.

22. See Coughlin and Pollard (2001) for a discussion using exports from US states.

Figure 10a
Canada's changing pattern of exports, 1985 and 2001

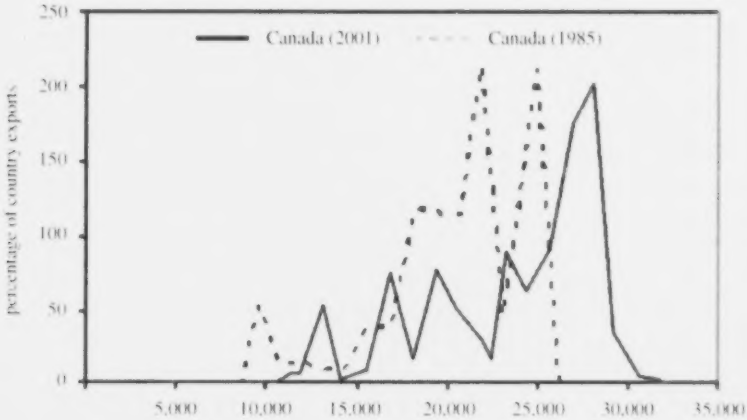


Figure 10b
Share of exports ranked by PSI, Canada and China (1985)

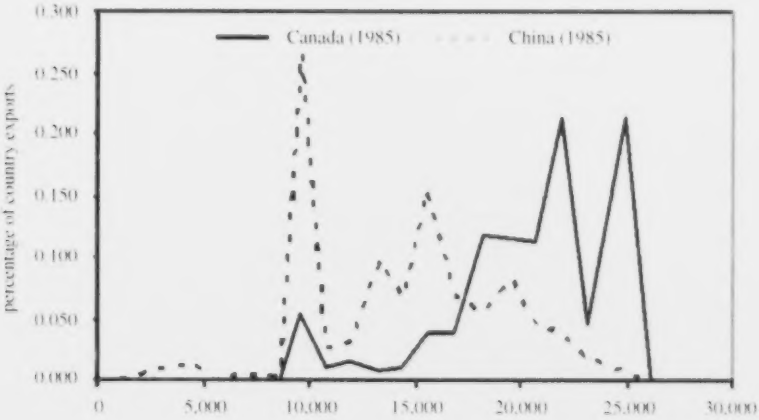


Figure 10c
Share of exports ranked by PSI, Canada and China (1985)

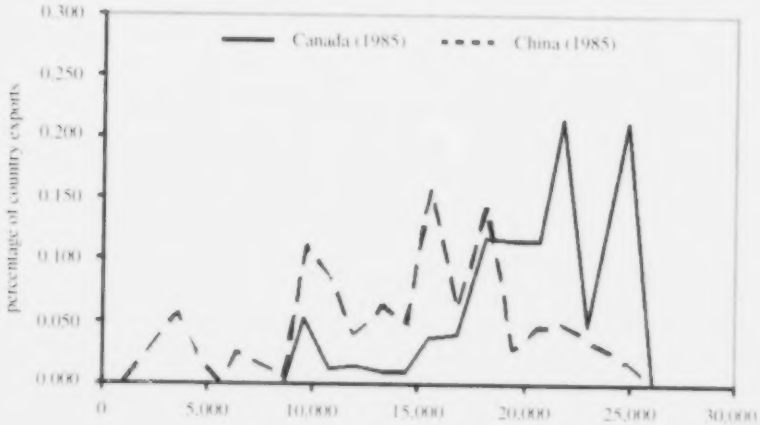


Figure 10d
Share of exports ranked by PSI, Canada and China (2001)

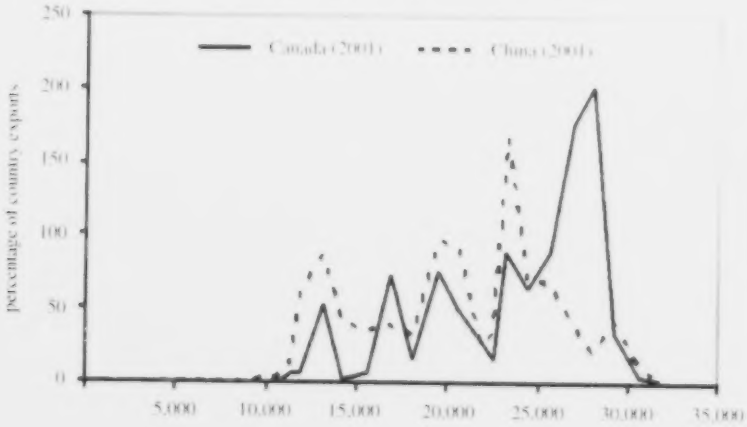
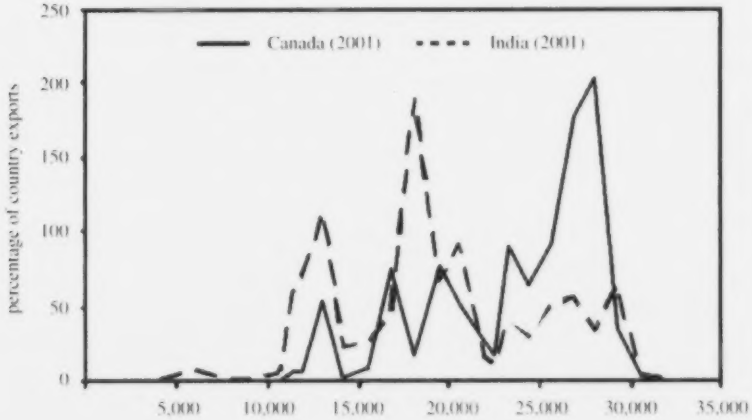


Figure 10e
Share of exports ranked by PSI, Canada and India (2001)



industry *i* exports would have risen in 2001 if they grew at the Canadian national average.

Equation 3 can be seen to be the sum of two components. The first is the destination-mix effect (DE), and the second is the industry-specific effect (IE). The destination effect captures that part of the NRC in industry *i* exports that occurs simply because there has been rapid growth in exports to a market that may have been a traditional destination for our exports. As stated, this will be important in factoring out some of the change in industry export performance that may have come from increased trade with the United States, for example. The second component is a residual. It captures that part of the net relative change in industry *i* exports that occurs because of better performance of that industry after controlling for destination effects. This second component is important for determining whether there has been a change in terms of trade, among other factors.

Tables 2a and b show the export shares for the top 20 Canadian exports, broken down by the three-digit SITC code (and PSI index number) for 1985 and 2001, respectively.[23] The last three columns show the net relative change and its breakdown into destination and industry effects. What is striking about Table 2a, which shows the 1985 top 20 exports, is that in each case when the industry had a positive NRC in the years that followed, it was

23. See Appendix 5 for a list of the top 20 bilateral exports between China and Canada and between India and Canada in 1985 and 2001.

Table 2a
Canada's top 20 merchandise exports, 1985

Rank	SITC classification	PSI 1985	Export share	NRC	DE	IE
1	781-Passenger motor cars, for transport of passengers	24,453	0.136	–0.111	0.098	–0.209
2	784-Parts and accessories of 722, 781, 782, 783	22,021	0.077	–0.498	0.105	–0.603
3	641-Paper and paperboard	21,561	0.056	–0.302	0.050	–0.352
4	782-Motor vehicles for transport of goods/materials	24,857	0.053	–0.268	0.089	–0.357
5	333-Petroleum oils and crude oils obtained from bituminous minerals	644	0.050	–0.195	0.100	–0.295
6	341-Gas, natural and manufactured	20,066	0.041	0.686	0.097	0.589
7	248-Wood, simply worked and railway sleepers of	18,157	0.040	–0.253	0.000	–0.253
8	041-Wheat (including spelt) and meslin, unmilled	19,119	0.032	–0.789	–0.625	–0.164
9	251-Pulp and waste paper	19,559	0.029	–0.373	–0.071	–0.302
10	971-Gold, non-monetary	16,492	0.020	–0.721	–0.002	–0.719
11	713-Internal combustion piston engines and parts	21,335	0.018	–0.250	0.095	–0.345
12	322-Coal, lignite, and peat	17,985	0.018	–0.699	–0.419	–0.280
13	684-Aluminum	20,362	0.016	0.052	–0.085	0.137
14	764-Telecommunications equipment and parts	24,624	0.016	0.455	–0.052	0.507
15	752-Automatic data processing machines and units	21,745	0.016	–0.640	0.027	–0.667
16	334-Petroleum products, refined	15,596	0.016	0.105	0.066	0.038
17	792-Aircraft and associated equipment and parts	20,722	0.014	1.277	–0.007	1.284
18	351-Electric current	22,356	0.012	–0.328	0.100	–0.427
19	287-Ores and concentrates of base metals, n.e.s.	11,350	0.012	–0.567	–0.187	–0.380
20	562-Fertilizers, manufactured	18,323	0.011	–0.346	–0.044	–0.302
ESI (for top 20)		20,523	0.681			
ESI (for all exports)		20,062				

Notes: NRC = net relative change; DE = destination-mix effect; IE = industry-specific effect.

Table 2b
Canada's top 20 merchandise exports, 2001

Rank	SITC code	PSI 2001	Export share	NRC	DE	IE
1	781-Passenger motor cars, for transport of passengers	28,289.924	0.121	0.111	0.098	–0.209
2	341-Gas, natural and manufactured	17,422.757	0.069	0.686	0.097	0.589
3	333-Petroleum oils and crude oils obtained from bituminous minerals	13,121.331	0.040	0.195	0.100	–0.295
4	641-Paper and paperboard	26,957.665	0.039	0.302	0.050	–0.352
5	782-Motor vehicles for transport of goods/materials	26,131.618	0.039	–0.268	0.089	–0.357
6	784-Parts and accessories of 722, 781, 782, 783	27,233.507	0.039	–0.498	0.105	–0.603
7	792-Aircraft and associated equipment and parts	28,296.417	0.033	1.277	–0.007	1.284
8	248-Wood, simply worked, and railway sleepers of	21,012.443	0.030	–0.253	0.000	–0.253
9	764-Telecommunications equipment and parts	23,210.279	0.023	0.455	–0.052	0.507
10	251-Pulp and waste paper	23,254.386	0.018	–0.373	–0.071	–0.302
11	821-Furniture and parts thereof	19,741.757	0.018	2.210	0.079	2.131
12	334-Petroleum products, refined	19,269.410	0.017	0.105	0.066	0.038
13	684-Aluminum	22,255.232	0.017	0.052	–0.085	0.137
14	583-Polymerization and copolymerization products	26,700.321	0.014	2.319	0.085	2.234
15	713-Internal combustion piston engines and parts	27,503.228	0.013	–0.250	0.095	–0.345
16	714-Engines and motors, non-electric	27,923.287	0.013	0.605	–0.026	0.631
17	893-Articles of materials described in division	23,860.643	0.011	7.240	0.065	7.176
18	011-Meat, edible meat offal, fresh, chilled, or frozen	24,931.288	0.011	0.511	–0.022	0.534
19	751-Office machines	22,439.782	0.011	58.932	–0.019	58.951
20	041-Wheat (including spelt) and meslin, unmilled	23,512.501	0.010	–0.789	–0.625	–0.164
ESI (for top 20)		23,842	0.587			
ESI (all exports)		23,745				

Notes: NRC = net relative change; DE = destination-mix effect; IE = industry-specific effect.

due to a positive industry effect. When exports fell, having a negative NRC, a negative industry effect was involved in each case. Regardless of whether the NRC was positive or negative, there was no obvious relationship between the destination effect and the NRC. The same story is true for the top 20 exports in 2001: industry effects always line up with the NRC.

The shift-share analysis therefore seems to suggest that industry-specific effects are important in explaining the changing pattern of Canadian exports. This is, however, only a selection of the top Canadian exports, and it doesn't allow one to examine the full extent of the relationship between industry export performance and PSI. We wanted to make sure that the rightward shift that we see in Figure 10a was due to industry effects (consistent with changing terms of trade) or destination effects (due to NAFTA). Therefore, we ran the correlation of the log of PSI (both 1985 and 2001) with the log of NRC+1, the log of IE+1, and the log of DE+1.[24] Table 3 reports the results.

Interestingly, the coefficients suggest a positive correlation between industry export performance (NRC) and the PSI index, but it is not statistically significant. However, once destination effects are accounted for, we find a positive and statistically significant correlation between the industry effect and the PSI score for the industry. This suggests that the Canadian industries that are becoming relatively more competitive in the global markets are those that are positively related to the PSI; however, this effect is being diluted somewhat by export growth in traditional export markets.[25]

This is a simple analysis of the determinants of comparative advantage and Canadian export performance, but it is consistent with our expectations. That is, Canadian exports are being affected by industry-specific effects that could be due to the growth and liberalization of trade between Canada and those countries lower down on the ladder of comparative advantage. In particular, trade with these countries is inducing specialization further up the ladder in Canada. Moreover, given Canada's capacity to finance ongoing investment in these high-PSI industries, we expect this process to continue to feed Canadian growth in the future. Clearly, more research needs to be done to confirm this hypothesis.

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24. Taking logs helps to deal with the problem that NRC is bounded below by −1. Our analysis omits 23 small industries, which had an expected value of exports in 2001 of < $25 million.

25. Simple correlations such as these should be treated with caution, since they do not consider many of the other factors that determine industry and destination effects other than the PSI number.

Table 3
Correlation coefficients between PSI and NRC and its components

	PSI 1985	PSI 2001
Industry-specific effect (IE)	0.1351	0.1298
	(0.061)	(0.0719)
Destination-mix effect (DE)	0.0892	0.1069
	(0.2173)	(0.1388)
Net relative change (NRC)	0.113	0.1512
	(0.1178)	(0.0358)

Notes: *P*-values in parentheses.
Number of observation: 193.

Conclusion

This paper examines the growth and integration of the economies of China and India in the content of the world economy and considers the implications for Canada. To perform our analysis, we turned to the literature and focused on four "puzzle" pieces that seemed relevant. The first observation was that China and India are growing, somewhat against empirical odds, given that over the long run, per capita incomes diverge widely across economies (Pritchett 1997). Second, as has been noted by a number of researchers, such as Rodrik, Subramanian, and Trebbi (2002), income levels and growth are now widely thought to depend on the quality of institutions. Third, trade can play an important role in the growth process by allowing countries to specialize and accumulate capital according to their comparative advantage (Findlay 1995). Fourth, it is reasonable to expect that institutions, aside from driving growth, also play a role in determining a country's comparative advantage relative to others (Beck 2002).

Putting these pieces of the "growth and integration" puzzle together, we believe, produces a simple, general theory that explains the pattern of trade and growth across economies. Using our framework, we can conclude that, given the quality of their institutions, China and India have somewhat taken the middle ground in world trade, exporting mostly middle-level goods in terms of their sophistication. As a result, trade liberalization has not contributed to the process of growth in these economies. Nevertheless, their economies have grown, driven by institutional reform, and their trade has expanded (especially in China). Moreover, if China and India continue to improve the quality of their institutions, our results suggest that they can expect trade to magnify the benefits of institutional reform. In response, countries like Canada have become somewhat more specialized in sophisticated goods, triggering a process of capital accumulation and higher levels of Canadian GDP. We expect this process of Canadian trade-induced

growth to continue as India and China make further improvements in the quality of economic institutions and integrate themselves into the world economy.

Appendix 1
The Ladder of Comparative Advantage, 1985 and 2001

Country Name	ESI 1985	ESI 2001	Rank 1985	Rank 2001	Change
Japan	22,650	26,089	1	2	-1
Switzerland	21,789	26,933	2	1	1
Germany	21,407	25,698	3	4	-1
Sweden	21,049	25,194	4	6	-2
Austria	20,537	24,956	5	8	-3
United States	20,511	25,198	6	5	1
France	20,370	25,079	7	7	0
Ireland	20,230	25,846	8	3	5
Finland	20,220	24,723	9	9	0
Canada	20,062	23,745	10	16	-6
Belgium-Luxemburg	19,978	24,253	11	11	0
Denmark	19,765	23,816	12	14	-2
Italy	19,461	23,369	13	21	-8
Netherlands	19,336	23,953	14	13	1
Bulgaria	19,120	20,083	15	46	-31
Spain	19,015	23,798	16	15	1
United Kingdom	18,893	24,585	17	10	7
Israel	18,767	22,634	18	23	-5
Hungary	18,698	23,521	19	19	0
Hong Kong	18,597	21,726	20	30	-10
Korea (Republic of)	18,562	23,632	21	18	3
Singapore	18,174	24,083	22	12	10
New Zealand	18,047	23,517	23	20	3
Romania	17,892	19,203	24	59	-35
Malta	17,819	23,296	25	22	3
Barbados	17,812	22,456	26	26	0
Iceland	17,769	21,840	27	29	-2
Portugal	17,466	21,505	28	32	-4
Argentina	16,952	20,831	29	39	-10
Bahrain	16,863	19,227	30	58	-28
Bolivia	16,830	19,327	31	57	-26
Australia	16,646	20,942	32	37	-5
Norway	16,476	18,085	33	69	-36
South Africa	16,474	21,000	34	36	-2
Malaysia	13,609	21,997	67	27	40
Trinidad and Tobago	13,473	20,118	68	44	24
Mauritius	13,281	14,583	69	100	-31
Ghana	13,258	20,047	70	48	22
Senegal	13,238	18,409	71	65	6
Gambia	13,228	17,022	72	77	-5
Tunisia	13,210	16,479	73	84	-11
Morocco	13,207	15,933	74	90	-16
Sierra Leone	13,183	20,107	75	45	30
Jamaica	13,173	14,967	76	98	-22
Congo (Dem. Rep. of)	13,013	17,357	77	73	4
Vietnam	12,970	15,384	78	97	-19
Mali	12,913	19,823	79	49	30
Panama	12,757	19,420	80	53	27
Guyana	12,654	17,010	81	78	3
Syrian Arab Republic	12,619	14,743	82	99	-17
Kiribati	12,380	20,121	83	43	40
Suriname	12,302	14,439	84	101	-17
Equatorial Guinea	12,172	14,034	85	106	-21
Costa Rica	12,099	20,908	86	38	48
Egypt	11,848	19,006	87	63	24
Papua-New Guinea	11,598	15,534	88	94	-6
Bangladesh	11,552	13,082	89	113	-24
Guatemala	11,470	18,606	90	64	26
Côte d'Ivoire	11,396	19,035	91	62	29
Mauritania	11,263	14,380	92	102	-10
Malawi	11,140	13,211	93	111	-18
Chad	11,027	17,954	94	71	23
Ecuador	10,670	16,159	95	87	8
Benin	10,501	17,988	96	70	26
Gabon	10,456	13,895	97	108	-11
Honduras	10,420	16,726	98	81	17
Cameroon	10,361	16,352	99	86	13
Oman	10,228	15,818	100	91	9

Country Name	ESI 1985	ESI 2001	Rank 1985	Rank 2001	Change
Cyprus	16.465	23.681	35	17	18
Turkey	16.370	19.560	36	52	-16
Uruguay	16.099	21.432	37	33	4
Seychelles	16.010	16.768	38	80	-42
Philippines	15.986	22.537	39	24	15
Brazil	15.786	21.361	40	34	6
Greece	15.643	20.068	41	47	-6
Albania	15.446	15.492	42	95	-53
Mongolia	15.407	15.407	43	96	-53
Haiti	15.172	14.341	44	105	-61
Zambia	15.035	19.821	45	50	-5
Belize	15.031	17.108	46	75	-29
Chile	14.901	19.802	47	51	-4
Thailand	14.725	21.241	48	35	13
Zimbabwe	14.717	17.095	49	76	-27
Mozambique	14.576	19.398	50	54	-4
Sudan	14.465	14.358	51	103	-52
Nepal	14.459	16.362	52	85	-33
Jordan	14.381	19.354	53	56	-3
India	14.376	19.192	54	60	-6
China	14.348	20.468	55	41	14
Solomon Islands	14.271	18.122	56	68	-12
Pakistan	14.252	16.602	57	83	-26
St. Kitts and Nevis	14.246	21.562	58	31	27
Fiji	14.033	16.148	59	88	-29
Bhutan	13.944	21.905	60	28	32
Burkina Faso	13.846	19.382	61	55	6
Peru	13.810	19.120	62	61	1
Paraguay	13.808	20.481	63	40	23
Dominican Rep.	13.731	17.262	64	74	-10
Mexico	13.705	22.522	65	25	40
Guinea-Bissau	13.651	16.130	66	89	-23
Congo (Republic of the)	10.226	14.347	101	104	-3
Colombia	10.222	18.292	102	66	36
Nicaragua	10.051	18.272	103	67	36
Angola	9.957	13.765	104	109	-5
Kenya	9.716	16.713	105	82	23
Ethiopia	9.702	16.941	106	79	27
El Salvador	9.636	20.345	107	42	65
Sri Lanka	9.584	13.935	108	107	1
Lao People's Dem. Rep.	9.293	15.599	109	93	16
Comoros	9.231	12.580	110	114	-4
Madagascar	8.572	13.578	111	110	1
Togo	8.288	15.677	112	92	20
Uganda	6.218	17.777	113	72	41
Burundi	6.168	13.197	114	112	2
Rwanda	6.131	11.022	115	115	0

Appendix 2
Sources and Definitions of Variables

Dependent Variable

1. Growth rate of per capita GDP in constant 1995 US dollars. Refer to (A) for source.

Explanatory variables

- *Economic and Financial Variables*

All variables are obtained from the World Bank's World Development Indicators and computed as five-year averages for periods 1972 to 1976, 1977 to 1981, 1982 to 1986, 1987 to 1991, 1992 to 1996, and 1997 to 2001.

1. Per capita GDP in constant 1995 US dollars.
2. Gross capital formation as a percentage of GDP.
3. General government final consumption expenditure as a percentage of GDP.
4. Overall government budget balance, including grants as a percentage of GDP.
5. Domestic credit to private sector as a percentage of GDP.
6. Domestic credit provided by banking sector as a percentage of GDP.
7. Consumer price index, 1995 = 100.
8. Imports of goods and services from the world in constant 1995 US dollars.
9. Exports of goods and services to the world in constant 1995 US dollars.
10. GDP in constant 1995 US dollars.
11. Total trade as a percentage of GDP. Computed as ((no. 11 + no. 12)/no. 13) from above.
12. Education levels: average years of secondary schooling in the total population, from the Barro-Lee data set on educational attainment.

- *Institutional Quality*

From the PRS Group's International Country Risk Guide.

1. Political risk.
2. Bureaucracy quality.
3. Corruption.
4. Democratic accountability.

5. Law and order.
6. Government stability.
7. Investment profile.

From the Fraser Institute's *Economic Freedom of the World: 2004 Annual Report*.

1. Legal system and property rights.

Appendix 3
List of Countries Used in Growth Regressions

IFS Code	Country Name
111	United States
112	United Kingdom
122	Austria
124	Belgium
128	Denmark
132	France
134	Germany
136	Italy
138	Netherlands
142	Norway
144	Sweden
146	Switzerland
156	Canada
158	Japan
172	Finland
174	Greece
176	Iceland
178	Ireland
181	Malta
182	Portugal
184	Spain
186	Turkey
193	Australia
196	New Zealand
199	South
213	Argentina
218	Bolivia
223	Brazil
228	Chile
238	Costa Rica
243	Dominican Republic
248	Ecuador
253	El Salvador
258	Guatemala
263	Haiti
268	Honduras
273	Mexico
278	Nicaragua
283	Panama
288	Paraguay
293	Peru
298	Uruguay
299	Venezuela

IFS Code	Country Name
336	Guyana
343	Jamaica
369	Trinidad and Tobago
419	Bahrain
423	Cyprus
429	Iran
436	Israel
439	Jordan
443	Kuwait
463	Syrian
469	Egypt
513	Bangladesh
518	Myanmar
524	Sri Lanka
532	Hong Kong
534	India
536	Indonesia
542	South Korea
548	Malaysia
564	Pakistan
566	Philippines
576	Singapore
578	Thailand
612	Algeria
616	Botswana
622	Cameroon
632	Comoros
636	Congo (Dem.)
652	Ghana
664	Kenya
676	Malawi
678	Mali
692	Niger
698	Zimbabwe
722	Senegal
724	Sierra Leone
742	Togo
744	Tunisia
746	Uganda
754	Zambia
853	Papua-New Guinea
924	China
944	Hungary
964	Poland

Note: IFS = International Financial Statistics

Appendix 4
Export Shares: Top 20 World Exports India and China

India 1985

Rank	SITC Code	PSI	Share
1	667-Pearls, precious and semiprecious stones, unworked	17,588	0.130
2	074-Tea and maté	3,537	0.058
3	281-Iron ore and concentrates	10,685	0.054
4	844-Undergarments of textile fabrics	9,604	0.046
5	334-Petroleum products, refined	15,596	0.046
6	611-Leather	15,078	0.038
7	652-Cotton fabrics, woven	15,851	0.037
8	036-Crustaceans and molluscs, fresh, chilled, frozen	9,537	0.034
9	659-Floor coverings, etc.	17,225	0.026
10	075-Spices	6,394	0.026
11	071-Coffee and coffee substitutes	4,775	0.024
12	057-Fruit and nuts (not including oil nuts), fresh or dried	10,976	0.024
13	658-Made-up articles, wholly/chiefly of textile materials	13,491	0.024
14	843-Outer garments, women's, of textile fabrics	14,647	0.023
15	612-Manufactures of leather or composition leather	12,432	0.022
16	654-Textile fabrics, woven, other than cotton/man-made	15,131	0.019
17	042-Rice	9,985	0.018
18	292-Crude vegetable materials, n.e.s.	16,464	0.018
19	541-Medicinal and pharmaceutical products	22,041	0.015
20	081-Feeding stuff for animals (no unmilled cereals)	15,813	0.014
ESI (for top 20)		12,853	0.694
ESI (all exports)		14,376	

China 1985

Rank	SITC Code	PSI	Share
1	333-Petroleum oils and crude oils obt. from bituminous mat.	9,644	0.241
2	334-Petroleum products, refined	15,596	0.066
3	652-Cotton fabrics, woven	15,851	0.037
4	651-Textile yarn	17,068	0.029
5	842-Outer garments, men's, of textile fabrics	13,610	0.025
6	658-Made-up articles, wholly/chiefly of textile materials	13,491	0.024
7	044-Maize (corn), unmilled	19,363	0.019
8	654-Textile fabrics, woven, other than cotton/man-made	15,131	0.017
9	653-Fabrics, woven, of man-made fibres	18,971	0.017
10	268-Wool and other animal hair (excluding wool)	14,280	0.016
11	845-Outer garments and other articles, knitted	13,949	0.016
12	263-Cotton	10,445	0.015
13	001-Live animals chiefly for food	15,962	0.015
14	899-Other miscellaneous manufactured articles	18,831	0.015
15	894-Baby carriages, toys, games, and sporting goods	16,857	0.014
16	851-Footwear	13,387	0.014
17	541-Medicinal and pharmaceutical products	22,041	0.014
18	056-Vegetable roots and tubers, prepared/preserved	13,687	0.013
19	261-Silk	4,145	0.013
20	322-Coal, lignite, and peat	17,985	0.013
ESI (for top 20)		13,217	0.632
ESI (all exports)		14,348	

India 2001

Rank	SITC Code	PSI	Share
1	667-Pearls, precious and semiprecious stones, unworked	18,149	0.134
2	651-Textile yarn	18,061	0.040
3	334-Petroleum products, refined	19,269	0.034
4	658-Made-up articles, wholly/chiefly of text. mat.	13,612	0.031
5	844-Undergarments of textile fabrics	11,424	0.028
6	036-Crustaceans and molluscs, fresh, chilled, frozen	11,406	0.025
7	846-Undergarments, knitted or crocheted	13,098	0.025
8	842-Outer garments, men's, of textile fabrics	11,811	0.024
9	897-Jewellery, goldsmiths and other art. of prec.	20,948	0.024
10	281-Iron ore and concentrates	12,360	0.023
11	541-Medicinal and pharmaceutical products	29,565	0.023
12	845-Outer garments and other articles, knitted	13,630	0.021
13	659-Floor coverings, etc	20,536	0.020
14	848-Articles of apparel and clothing accessories	11,457	0.017
15	514-Nitrogen function compounds	28,989	0.014
16	652-Cotton fabrics, woven	18,249	0.014
17	843-Outer garments, women's, of textile fabrics	12,675	0.013
18	515-Organo inorganic and heterocyclic compounds	29,275	0.013
19	851-Footwear	13,952	0.012
20	611-Leather	16,946	0.012
ESI (for top 20)		17,159	0.55
ESI (all exports)		19,192	1

China 2001

Rank	SITC Code	PSI	Share
1	764-Telecommunications equipment and parts	23,210	0.074
2	752-Automatic data processing machines and units	23,266	0.049
3	842-Outer garments, men's, of textile fabrics	11,811	0.043
4	894-Baby carriages, toys, games, and sporting goods	20,122	0.037
5	851-Footwear	13,952	0.037
6	845-Outer garments and other articles, knitted	13,630	0.034
7	751-Office machines	22,440	0.033
8	778-Electrical machinery and apparatus, n.e.s.	25,663	0.025
9	775-Household type, elect. and non-electrical equipment	19,311	0.020
10	893-Articles of materials described in division	23,861	0.020
11	821-Furniture and parts thereof	19,742	0.019
12	776-Thermionic, cold and photo-cathode valves	24,740	0.018
13	846-Undergarments, knitted or crocheted	13,098	0.016
14	848-Articles of apparel and clothing accessories	11,457	0.016
15	658-Made-up articles, wholly/chiefly of textile materials	13,612	0.015
16	831-Travel goods, handbags, briefcases, purses	16,566	0.015
17	899-Other miscellaneous manufactured articles	23,521	0.015
18	771-Electric power machinery and parts thereof	21,704	0.014
19	772-Electrical apparatus such as switches, relays, fuses	25,719	0.013
20	844-Undergarments of textile fabrics	11,424	0.012
ESI (for top 20)		19,301	0.53
ESI (all exports)		20,468	1

Notes:
ESI: export sophistication index.
PSI: product sophistication index.

Appendix 5
Export Shares: Top 20 Bilateral Exports

China's exports to Canada, 1985

Rank	SITC Code	PSI	Share
1	056-Vegetable roots and tubers, prepared/preserved	13,687	0.133
2	652-Cotton fabrics, woven	15,851	0.120
3	653-Fabrics, woven, of man-made fibres	18,971	0.106
4	658-Made-up articles, wholly/chiefly of text. mat	13,491	0.097
5	057-Fruit and nuts (not including oil nuts), fresh or dried	10,976	0.088
6	894-Baby carriages, toys, games, and sporting goods	16,857	0.049
7	654-Textile fabrics, woven, other than cotton/man-made	15,131	0.035
8	263-Cotton	10,445	0.025
9	659-Floor coverings, etc.	17,225	0.024
10	851-Footwear	13,387	0.024
11	694-Nails, screws, nuts, bolts, etc. of iron, steel	22,199	0.019
12	541-Medicinal and pharmaceutical products	22,041	0.019
13	699-Manufactures of base metal, n.e.s.	20,282	0.017
14	899-Other miscellaneous manufactured articles	18,831	0.016
15	523-Other inorganic chemicals	20,225	0.011
16	893-Articles of materials described in division	20,501	0.011
17	287-Ores and concentrates of base metals, n.e.s.	11,350	0.010
18	769-Old clothing and other old textile articles	22,365	0.009
19	058-Fruit, preserved, and fruit preparations	12,027	0.009
20	074-Tea and maté	3,537	0.008
ESI (for top 20)		15,360	0.83

Export Shares: Top 20 Bilateral Exports

India's Exports to Canada, 1985

Rank	SITC Code	PSI	Share
1	844-Undergarments of textile fabrics	9,604	0.215
2	843-Outer garments, women's, of textile fabrics	14,647	0.123
3	659-Floor coverings, etc.	17,225	0.074
4	667-Pearls, precious and semiprecious stones	17,588	0.063
5	287-Ores and concentrates of base metals, n.e.s.	11,350	0.053
6	654-Textile fabrics, woven, other than cotton/man-made	15,131	0.050
7	896-Works of art, collectors' pieces and antiques	20,073	0.045
8	075-Spices	6,394	0.045
9	071-Coffee and coffee substitutes	4,775	0.043
10	842-Outer garments, men's, of textile fabrics	13,610	0.032
11	611-Leather	15,078	0.025
12	074-Tea and maté	3,537	0.020
13	057-Fruit and nuts (not including oil nuts)	10,976	0.016
14	292-Crude vegetable materials, n.e.s.	16,464	0.014
15	424-Other fixed vegetable oils, fluid or solid	8,697	0.013
16	523-Other inorganic chemicals	20,225	0.013
17	042-Rice	9,985	0.013
18	658-Made-up articles, wholly/chiefly of textile materials	13,491	0.011
19	652-Cotton fabrics, woven	15,851	0.011
20	851-Footwear	13,387	0.010
ESI (for top 20)		12,660	0.89

Export Shares: Top 20 Bilateral Exports

Canada's exports to India, 1985			
Rank	**SITC Code**	**PSI**	**Share**
1	423-Fixed vegetable oils, soft, crude, refined	15,637	0.231
2	274-Sulphur and unroasted iron pyrites	18,231	0.175
3	562-Fertilizers, manufactured	18,323	0.118
4	251-Pulp and waste paper	19,559	0.073
5	278-Other crude minerals	14,682	0.058
6	641-Paper and paperboard	21,561	0.055
7	723-Civil engineering and contractors' plant and equipment	22,952	0.050
8	054-Vegetables, fresh, chilled, frozen	13,879	0.028
9	686-Zinc	17,955	0.028
10	674-Universals, plates, and sheets of iron	22,680	0.018
11	764-Telecommunications equipment and parts	24,624	0.014
12	682-Copper	15,016	0.014
13	233-Synthetic rubber	21,568	0.011
14	683-Nickel	19,449	0.009
15	784-Parts and accessories of 722, 781, 782	22,021	0.008
16	714-Engines and motors, non-electric	21,189	0.008
17	782-Motor vehicles for transport of goods/materials	24,857	0.008
18	728-Machinery and equipment specialized for part. indust.	23,189	0.007
19	541-Medicinal and pharmaceutical products	22,041	0.006
20	931-Special transactions and commodities, not classified according to kind	19,621	0.006
ESI (for top 20)		18,171	0.93

Export Shares: Top 20 bilateral exports

Canada's exports to China, 1985			
Rank	**SITC Code**	**PSI**	**Share**
1	041-Wheat (including spelt) and meslin, unmilled	19,119	0.388
2	641-Paper and paperboard	21,561	0.089
3	251-Pulp and waste paper	19,559	0.060
4	562-Fertilizers, manufactured	18,323	0.043
5	686-Zinc	17,955	0.041
6	682-Copper	15,016	0.035
7	287-Ores and concentrates of base metals, n.e.s.	11,350	0.030
8	233-Synthethic rubber	21,568	0.029
9	723-Civil engineering and contractors' plant and equipment	22,952	0.028
10	583-Polymerization and copolymerization products	21,549	0.026
11	274-Sulphur and unroasted iron pyrites	18,231	0.025
12	248-Wood, simply worked, and railway sleepers of wood	18,157	0.025
13	782-Motor vehicles for transport of goods/materials	24,857	0.023
14	247-Other wood in the rough or roughly squared	13,184	0.022
15	792-Aircraft and associated equipment and parts	20,722	0.019
16	764-Telecommunications equipment and parts	24624	0.016
17	046-Meal and flour of wheat and flour of meslin	19,116	0.011
18	512-Alcohols, phenols, phenol-alcohols, and their der.	19,894	0.008
19	714-Engines and motors, non-electric	21,189	0.008
20	266-Synthetic fibres suitable for spinning	20,800	0.008
ESI (for top 20)		19,269	0.94

Export Shares: Top 20 Bilateral Exports

Canada's exports to India, 2001			
Rank	**SITC Code**	**PSI**	**Share**
1	054-Vegetables, fresh, chilled, frozen/preserved, roots	18,816	0.30
2	641-Paper and paperboard	26,958	0.12
3	251-Pulp and waste paper	23,254	0.10
4	871-Optical instruments and apparatus	30,279	0.08
5	665-Glassware	25,219	0.07
6	562-Fertilizers, manufactured	17,739	0.07
7	278-Other crude minerals	19,256	0.05
8	287-Ores and concentrates of base metals, n.e.s.	12,844	0.03
9	674-Universals, plates and sheets, of iron or steel	25,796	0.02
10	728-Mach. and equip. specialized for particular industries	29,792	0.02
11	764-Telecommunications equipment and parts	23,210	0.01
12	931-Special transactions and commodities, not classified	26,555	0.01
13	233-Synthetic rubber	26,710	0.01
14	774-Electric apparatus for medical purposes	30,366	0.01
15	714-Engines and motors, non-electric	27,923	0.01
16	772-Electrical apparatus, such as switches, relays, fuses	25,719	0.01
17	751-Office machines	22,440	0.01
18	874-Measuring, checking, analyzing instruments	28,997	0.01
19	266-Synthetic fibres suitable for spinning	25,300	0.01
20	269-Old clothing and other old textile articles	24,841	0.00
ESI (for top 20)		22,470	0.92

Export Shares: Top 20 Bilateral Exports

China's exports to Canada, 2001			
Rank	**SITC Code**	**PSI**	**Share**
1	842-Outer garments, men's, of textile fabrics	11,811	0.07
2	894-Baby carriages, toys, games, and sporting goods	20,122	0.05
3	851-Footwear	13,952	0.05
4	764-Telecommunications equipment and parts	23,210	0.05
5	831-Travel goods, handbags, briefcases, purses	16,566	0.04
6	848-Articles of apparel and clothing accessories	11,457	0.04
7	821-Furniture and parts thereof	19,742	0.03
8	893-Articles of materials described in division	23,861	0.03
9	775-Household type electrical and non-electrical equipment	19,311	0.03
10	845-Outer garments and other articles, knitted	13,630	0.03
11	658-Made-up articles, wholly/chiefly of textile materials	13,612	0.03
12	778-Electrical machinery and apparatus, n.e.s.	25,663	0.02
13	844-Undergarments of textile fabrics	11,424	0.02
14	752-Automatic data processing machines and units	23,266	0.02
15	899-Other miscellaneous manufactured articles	23,521	0.02
16	699-Manufactures of base metal, n.e.s.	23,554	0.02
17	812-Sanitary, plumbing, heating, lighting fixtures	20,403	0.02
18	784-Parts and accessories of 722, 781, 782	27,234	0.02
19	695-Tools for use in hand or in machines	26,662	0.01
20	749-Non-electric parts and accessories of machinery	27,406	0.01
ESI (for top 20)		18,362	0.61

Export Shares: Top 20 Bilateral Exports

India's Exports to Canada, 2001			
Rank	**SITC Code**	**PSI**	**Share**
1	846-Undergarments, knitted or crocheted	13,098	0.13
2	842-Outer garments, men's, of textile fabrics	11,811	0.06
3	845-Outer garments and other articles, knitted	13,630	0.05
4	844-Undergarments of textile fabrics	11,424	0.05
5	667-Pearls, precious and semiprecious stones, unworked	18,149	0.04
6	651-Textile yarn	18,061	0.04
7	658-Made-up articles, wholly/chiefly of textile materials	13,612	0.04
8	659-Floor coverings, etc	20,536	0.03
9	541-Medicinal and pharmaceutical products	29,565	0.03
10	514-Nitrogen-function compounds	28,989	0.03
11	036-Crustaceans and molluscs, fresh, chilled, frozen	11,406	0.02
12	749-Non-electric parts and accessories of machinery	27,406	0.02
13	897-Jewellery, goldsmiths' and other art. of prec. or semi-prec. mat.	20,948	0.02
14	851-Footwear	13,952	0.02
15	515-Organo-inorganic and heterocyclic compounds	29,275	0.02
16	843-Outer garments, women's, of textile fabrics	12,675	0.02
17	848-Articles of apparel, and clothing accessories excl. textile	11,457	0.02
18	075-Spices	10,266	0.02
19	287-Ores and concentrates of base metals, n.e.s.	12,844	0.02
20	654-Textile fabrics, woven, other than cotton/man-made	20,700	0.01
ESI (for top 20)		16,209	0.68

Export Shares: Top 20 Bilateral Exports

Canada's exports to China, 2001			
Rank	**SITC Code**	**PSI**	**Share**
1	251-Pulp and waste paper	23,254	0.14
2	792-Aircraft and associated equipment and parts	28,296	0.10
3	222-Oil seeds and oleaginous fruit, whole or broken	19,810	0.09
4	562-Fertilizers, manufactured	17,739	0.08
5	512-Alcohols, phenols, phenol-alcohols and their derivation	24,259	0.06
6	764-Telecommunications equipment and parts	23,210	0.06
7	784-Parts and accessories of 722, 781, 782	27,234	0.05
8	043-Barley, unmilled	24,455	0.04
9	524-Radio-active and associated materials	25,050	0.03
10	583-Polymerization and copolymerization products	26,700	0.03
11	287-Ores and concentrates of base metals, n.e.s.	12,844	0.03
12	041-Wheat (including spelt) and meslin, unmilled	23,513	0.02
13	266-Synthetic fibres suitable for spinning	25,300	0.02
14	714-Engines and motors, non-electric	27,923	0.02
15	036-Crustaceans and molluscs, fresh, chilled, frozen	11,406	0.02
16	728-Mach. and equip. specialized for particular industries	29,792	0.01
17	274-Sulphur and unroasted iron pyrites	23,182	0.01
18	211-Hides and skins (except fur skins), raw	25,110	0.01
19	282-Waste and scrap metal of iron or steel	24,197	0.01
20	749-Non-electric parts and accessories of machinery	27,406	0.01
ESI (for top 20)		23,246	0.83

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Discussion

Steven Kamin*

I have greatly enjoyed the opportunity to work with colleagues from the Bank of Canada on various issues over the years, and so it is a genuine pleasure to be here today to comment on an interesting and extremely topical paper.

I should note at the outset that the study by Desroches, Francis, and Painchaud is a work in progress. The authors address three substantial and distinct topics—(i) the evolution of the economies of China and India; (ii) cross-country correlations among growth, trade, and institutions; and (iii) the impact of China and India's emergence on Canada—but the paper is still feeling its way through to integrating the issues in a single analysis.

I will focus on the third topic, which I believe to be particularly important. As shown in Table 1, if recent trends in GDP growth continue, China, in particular, will grow to 24 per cent of the global economy by 2050. This will likely have significant effects on the global economy.

Thus, the research by Desroches, Francis, and Painchaud is extremely timely. I interpret their work as applying to the long run, when labour and capital are fully utilized, resources are fully reallocated according to comparative advantage, and, therefore, when China and India's growth is most likely to be beneficial for the industrialized economies. In the short term, however, additions to global supply could, in principle, outstrip demand, disrupting the global economy. Many commentators have high-

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Table 1
The growing role of China and India in the global economy
(percentage)

	China	India	US	Canada	Japan	Other East Asia***
Share of world population, 2002*	21	17	5	1	2	7
Share of world economy, 2002*	3	2	32	2	14	5
Assumed future GDP growth**	8	6	3	3	2	5
Share of world economy, 2050	24	5	24	2	6	8

Notes:
* Source: 2004 World Development Indicators.
** Loosely based on 1990–2002 growth rates.
*** Includes: Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand.

lighted this threat, but how big is it really? Before I address the authors' long-run analysis, I'd like to sketch out an extremely crude estimate of China's current impact on Canadian and US growth. It is based generally on data for 2003, but I would emphasize that it is intended to be suggestive rather than definitive.

The top panel of Table 2 outlines the first channel of impact: China is lowering the prices that industrialized countries pay for manufactures, thus raising their terms of trade. A paper I wrote with colleagues at the Federal Reserve (Kamin, Marazzi, and Schindler 2004) estimates that Chinese exports have lowered overall import costs by about 0.75 per cent annually in Canada and 1.25 per cent in the United States. This raises real income by about 0.1 per cent in the United States and 0.2 per cent in Canada—we then assume it raises total demand and GDP growth by three-quarters of this amount in the short run.

Offsetting this gain, as shown in the second panel, is the divergence of industrial country demand from domestic to Chinese production. Assuming unit elasticities of demand for imports, China's action in lowering import prices leads to a proportionate rise in import volumes. This implies a leakage from GDP growth of roughly 0.2 percentage points for the United States and Canada, more than offsetting the benefits of improved terms of trade discussed above.

A third channel of impact is higher exports to China. I arbitrarily assume that any Chinese growth above 3 per cent is "exceptional," and that this exceptional growth leads (assuming a unit elasticity of Chinese imports with

Table 2
Guesstimate of short-term impact of Chinese growth on United States and Canada (percentage)

	United States	Canada
Channel 1: Effect of reduced import prices		
Change in import prices	–1.25%	–0.75%
Savings to import bill	+$15.8B	+C$2.6B
Savings/nominal GDP	+0.14%	+0.21%
Rise in spending/real GDP	**+0.11%**	**+0.16%**
Channel 2: Effect of higher imports from China		
Change in import prices	–1.25%	–0.75%
Change in import volumes	+1.25%	+0.75%
Change in real GDP	**–0.14%**	**–0.21%**
Channel 3: Effect of higher exports to China		
"Exceptional" Chinese growth	+5%	+5%
Exports to China/nominal GDP	0.37%	0.45%
Change in real GDP	**+0.02%**	**+0.02%**

	Oil	Copper	Cotton
Channel 4: Effect of higher commodity prices			
Annual price change*	21%	37%	9%
Annual demand change*	2.8%	2.6%	0.7%
China contribution to demand change*	+0.8%	+1.8%	+2.2%
China contribution to price change (guesstimate)	**+5.9%**	**+25.0%**	**+9%**
Canada			
Net exports/GDP	1.20%	0.07%	–0.01%
Change in net exports/GDP	+0.07%	+0.02%	–0.00%
Change in spending/GDP	**+0.05%**	**+0.01%**	**–0.00%**
United States			
Net exports/GDP	–1.05%	–0.01%	0.03%
Change in net exports/GDP	–0.06%	–0.00%	+0.00%
Change in spending/GDP	**–0.05%**	**–0.00%**	**+0.00%**

*Averaged over 2002–04

	United States	Canada
Summary		
Channel 1: Lower import prices	+0.11%	+0.16%
Channel 2: Higher import volumes	–0.14%	–0.21%
Channel 3: Higher export volumes	+0.02%	+0.02%
Channel 4: Higher commodity prices	–0.05%	+0.06%
Total	**–0.06%**	**+0.03%**

Notes: Calculations in this table are based primarily on data for 2003, and derive from various sources, including: International Monetary Fund, *International Financial Statistics* and *Direction of Trade Statistics*; Industry Canada, online database; International Copper Study Group; Statistics Canada; Energy Information Administration, *International Petroleum Monthly*; US Department of Commerce; and US Department of Agriculture.

respect to GDP) to proportionate additional growth in Canadian and US exports to China. Given the low level of exports to China, I guesstimate that recent Chinese growth has boosted Canadian and US GDP growth by only tiny amounts.

Finally, a fourth channel provides a drag on industrial country growth: China's impact on primary commodity prices. The table displays calculations for three important commodities, but others would be included in a comprehensive analysis. Focusing on the example of oil, prices have risen about 21 per cent annually over the past few years, while growth in Chinese demand has contributed almost one-third of the 2.8 per cent annual growth in global demand. If we assume, somewhat unrealistically, that all of the run-up in oil prices owes to higher demand, then we can attribute almost a third of that run-up—or 5.9 per cent—to Chinese growth alone. Then, taking into account the net export positions in oil of Canada and the United States, we estimate that Chinese oil-price effects have boosted income by roughly 0.1 per cent in Canada and reduced income by the same extent in the United States. Then, as before, we assume that three-quarters of these income effects translate into changed growth in GDP. The analysis of China's effect on the other commodity prices follows a similar approach.

Adding together all four effects (the last panel of Table 2), we see that US growth is lowered 0.06 percentage point annually, while Canadian growth is raised 0.03 percentage point. While keeping in mind how simplistic this exercise is, these short-term impacts are quite small, suggesting that China is going to have to become a considerably larger player in the global economy before its impact on Canada and the United States begins to approach the predictions of some commentators.

Now, in the long run, as I've noted, China and India will likely have a more positive impact on the industrialized economies. But how does one quantify the productivity gains resulting from more trade with these countries? Here, the authors offer a rather clever approach: they estimate a multi-country panel regression linking GDP growth to various determinants, including the ratio of trade to GDP. They then use their results to gauge the effect of increased trade with China on Canadian growth, putting it at 1.9 percentage point over a five-year period, or about 0.4 percentage point at an annual rate. Initially, I thought it was a bit bizarre to lift a regression out of a literature focused on structural reform and developing country growth, and apply the equation to the case of growth in Canada. Further reflection, however, persuaded me that the primary means by which China will affect Canada is by boosting trade, and this is exactly the effect that openness variables in cross-country growth regressions attempt to capture. Thus, the paper holds

the promise of using a straightforward back-of-the-envelope calculation to solve a difficult problem.

All that said, I do not take the results of the calculation very seriously. First, the trade-openness variable in the growth regression could easily be proxying for structural economic policies and institutions, rather than measuring the effects of openness per se; while institutional quality is held constant, this variable appears to capture mainly political and legal issues, and does not necessarily act as a good control for economic policies. Second, there is a huge literature devoted to estimating different variants of this regression, and one of the key lessons from this literature is that small differences in dynamic specification, explanatory variables, or instruments lead to big differences in coefficients—thus, I doubt that the estimated effect on growth of a 1 percentage point rise in openness is robust. Third, the coefficient on the trade-openness variable itself is estimated very imprecisely—therefore, a negative overall impact of greater openness on growth certainly falls within the model's 95 per cent confidence interval. Finally, I find the estimated effect of 1 percentage point greater openness on annual growth—0.4 percentage point—to be implausibly high. For example, the ratio of Canadian trade to GDP has risen about 20 percentage points since 1990—it is impossible to believe that growth should have risen 8 percentage points as a result. By this reckoning, the effect of NAFTA on Canadian growth should have been truly enormous!

As the authors acknowledge, even if their calculations were more reliable, the growth-regression approach is a bit of a black box: it tells you by how much trade with China boosts Canadian growth, but does not say why or how. Of course, any economist can answer that in general terms: trade with China should raise Canadian productivity by promoting specialization along lines of comparative advantage, so that Canada imports more goods that are intensive in low-skilled labour and produces more goods that are intensive in capital and high-skilled labour. The difficulty is to quantify this shift in product mix. The authors solve this problem by taking all the types of goods traded by China, India, and Canada, and assigning to each type of good a "product sophistication index," or PSI. This PSI is measured as the average real purchasing-power parity per capita income of the countries that export this type of good, weighted by their share in the global market for that good. Thus, the PSI for men's cotton underwear will probably look something like the per capita income of Honduras, while the PSI for precision machine tools may be closer to Germany's. The PSI approach is ingeniously simple and it works, as long as per capita incomes across economies are correlated with their endowments of capital and skilled labour, a not unreasonable assumption.

Using this approach, the authors document several interesting results. First, as one would expect, Canada exports a relatively high PSI mix of goods to China and India, and imports a relatively low PSI mix of goods from them in return. Second, the PSIs of Canadian exports to all countries have increased between 1985 and 2001, consistent with the view that Canada is specializing in producing higher-sophistication goods while giving up activities in the lower-sophistication goods categories. These results thus put some flesh on the bones of the argument that trade with developing countries promotes specialization in high-skilled, capital-intensive activities.

That said, I'd like to highlight two concerns. First, at least some of the increase in PSIs of Canada's exports between 1985 and 2001 may merely reflect increases in global per capita incomes; thus, even if Canada's export mix remained exactly the same, the PSIs of its exports could rise as the incomes of countries producing those goods rise. This suggests that what we'd like to see in response to low-priced import competition is not just an increase in Canada's PSIs, but an increase relative to that of other countries. I think the authors need to look into this more closely. Second, even if Canada's export mix has genuinely shifted towards more sophisticated products, the paper offers no evidence tying this shift directly to China and India. It might be useful for the authors to explore the change in PSIs for a broad range of industrial economies, and determine whether those countries whose trade with China rose the most were also those whose PSIs rose the most. Again, NAFTA seems like an important candidate for any changes in the Canadian export mix.

In conclusion, this paper is perhaps over-ambitious in its attempt to address too many important issues. I am convinced, however, that much of the work is interesting and will yield useful results with additional effort.

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Economic Integration in Europe: Its Effects on Canada

*Richard Cameron, Denise Côté, and Christopher Graham**

> It is not possible to forecast with any degree of precision the probable over-all effects on Canadian trade of the current movement towards European integration. . . . If the United Kingdom becomes a Member of the [European] Community, the long-term advantages will have to be very great to compensate Canada for the loss of the preferential position now enjoyed in the U.K. market.
>
> L.D. Wilgress (1962, 25)

Introduction

For the past half century, European countries have undertaken a series of measures that have liberalized trade and factor flows among member states of the European Union (EU). They have also harmonized various

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government policies, including external commercial policy and monetary policy. As a result of these changes, the EU has extended beyond the definition of a common market and is approaching an economic and possibly a political union. Consequently, this increased integration has greatly expanded economic transactions within Europe, possibly at the expense of trade and factor flows with non-member states, including Canada. Accordingly, the purpose of this paper is to examine how Europe's increasing economic integration has affected its trade with Canada.

From a historical perspective, the increase in postwar economic integration in Europe began in earnest with the 1957 Treaty of Rome and was gradually intensified over the years by legislation such as the Single European Act of 1987. This latter act in particular caused concern that the removal of barriers to trade between European nations could come at the expense of extra-EU trade partners. This apprehension regarding the construction of a "Fortress Europe" was especially pronounced among US and Japanese authorities during the late 1980s and early 1990s (Aho 1994).[1]

From the Canadian perspective, following the United Kingdom's initiative to co-found the European Free Trade Association (EFTA) in 1960, concerns were expressed regarding the possible impact on Canadian exports of the United Kingdom's prospective entry into the European Economic Community (EEC) (Wilgress 1962; Nadeau 1985; Hart 2002).[2] Indeed, at the time, the United Kingdom was Canada's second most important trading partner after the United States, and many Canadian exports, along with those of other Commonwealth countries (i.e., Australia and New Zealand), enjoyed long-standing preferential treatment in the British market.[3] In the end, the United Kingdom joined the European Community (EC) in 1973, at which time the special access afforded to Canadian exports in the British market came to an end. Tariff preferences were lost, and from that point on, Canadian exports faced the EC's common external tariffs, while competing imports into the United Kingdom from other members of the Community were admitted free of tariffs.

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1. Such concerns were significant, given that the United States and the EU in particular maintain the largest bilateral trading and investment relationship in the world, with investors from the EU supplying a substantial amount of capital to the United States.

2. The EFTA originally included six countries in addition to the United Kingdom, namely, Austria, Denmark, Norway, Portugal, Sweden, and Switzerland. The EEC originally included six countries, namely, Belgium, Luxembourg, France, the Federal Republic of Germany, Italy, and the Netherlands. See section 1 for more details.

3. In the mid-1940s, the United Kingdom's share of Canadian exports was about 27 per cent, while that of the United States was 37 per cent. In 2003, the United Kingdom's share was 1.6 per cent and United States' share was 86 per cent.

Partly in response to these concerns, a significant body of literature has grown to analyze the impact of increased European integration on trade and factor flows. Most of this research has focused on two central issues: the effect of commercial integration (or customs unions) and the effect of currency integration (or monetary unions) on trade and real GDP. The latter aspect has come under increased scrutiny since the advent of the European monetary union (EMU) in 1999.[4]

With regard to the effects of the EC on the welfare of European countries, Balassa (1967, 1975) provides evidence of net trade creation resulting from the Common Market.[5,6] Similarly, a 1995 United Nations study finds evidence of trade creation between the EFTA and EC countries following the liberalization of trade between the two country groups in 1973; however, this trade creation was accompanied by some trade diversion in the case of North America. Haaland (1993) investigates the welfare effects of the EC and the EFTA, finding evidence of positive welfare effects for the EFTA and EC countries, with the former area benefiting the most, and some degree of trade diversion for the United States and Japan. Similar conclusions are reached by Haaland and Norman (1992) and Winters (1997). In a survey of the literature regarding the economic effects of EC integration, Ohly (1993) argues that the consensus view suggests that the overall effects of EC integration are positive. Papadaki (1998) evaluates the welfare effects of the Europe 1992 program (i.e., the removal of non-tariff barriers) in a general multi-country, multi-sector equilibrium model. Her results show that all EU countries are likely to benefit from the completion of the single European market (Common Market), with Italy, Greece, and the United Kingdom benefiting the most (i.e., seeing the largest gains in welfare) and with a

4. For a brief but thorough literature review on this issue, see Rose (2004) and references therein.

5. Balassa uses an ex post income elasticity analysis of Common Market trade (income elasticities of demand for imports of all commodities). It has since been argued that income elasticities varied substantially pre- and post-integration, making Balassa's results sensitive to the sample period.

6. In Viner's framework, as discussed by Clausing (2001), trade creation occurs when the lowering of tariffs allows partner-country imports to replace high-cost domestic production; this improves welfare. Trade diversion occurs when the removal of tariffs causes trade to be diverted from a third country in favour of trade with the partner country, despite the fact that, were the countries treated equally, the third country would be the lower-cost source of imports. Overall welfare increases when gains to consumer surplus outweigh the loss of tariff revenue and producer surplus. Welfare therefore depends on the extent of trade creation relative to trade diversion.

limited degree of trade diversion for the rest of the world.[7] Focusing more specifically on the effects of Western European integration on third-party countries, Head and Mayer (2001) find evidence of an important increase in the difficulty faced by American and Japanese producers in accessing the European market during the early 1980s. At the same time, the authors find evidence of a gradual fall in border effects for intra-European trade.[8]

Studies regarding the economic impact of increased European integration on Canada are very limited, likely because the EU accounts for a relatively small share of Canada's total trade (5 per cent of total Canadian exports and 10 per cent of total Canadian imports as of 2003). Moreover, even though the level of trade between Canada and the EU has continued to grow during the past fifty years, it has risen at a slower rate than Canada's trade with other regions of the world. Consequently, overall trade between Canada and the EU has fallen as a share of each area's total trade. Nonetheless, although this share is only a small fraction of that of the United States, the EU remains economically important as Canada's second largest trading partner.[9]

One of the few studies on EU integration and Canada-EU trade is a report presented by the Canadian Standing Senate Committee on Foreign Affairs, entitled *European Integration: The Implications for Canada*. This report identified several potential implications for Canada regarding Europe's upcoming monetary union, including: the effect of EMU on the Canadian-dollar exchange rate, the effect on trade and investment patterns between Canada and the EU, implications for the balance of power in international economic policy coordination forums such as the G-7, and the spectre of increased protectionism, including the creation of a "Fortress Europe." The report went on to make twenty-five related recommendations. Of particular interest, the Committee suggested that studies be undertaken to assess Canada-EU trade patterns and to discover in which sectors of the EU market Canada is losing or gaining market share. The Committee also recommended an analysis of the potential impact on Canada of future EU expansion, with a focus on potential "trade and investment diversion." Finally, the Committee recommended that the Department of Foreign

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7. Similar welfare analyses have been performed on the topic of Canada-United States economic integration. For example, Clausing (2001) examined the effects of the Canada-United States Free Trade Agreement on trade patterns at the commodity level and found substantial trade creation effects resulting from tariff removal, with little evidence of trade diversion with other countries.

8. Head and Mayer use the border-effect methodology over the 1976–95 period.

9. In terms of individual countries, China is currently Canada's second largest trading partner in total merchandise trade, having overtaken Japan in 2003. However, Japan remains Canada's second largest export market, while China now holds that position in terms of Canadian imports. The United States retains the top ranking.

Affairs and International Trade (DFAIT), in consultation with the Bank of Canada and the Department of Finance, undertake a study on the effects on Canada of the EU's economic and monetary union.

The following year, DFAIT released a study entitled *European Monetary Union and Its Implications for Canada*. This study, by Robert Hannah (1997), examined the proposed EMU and concluded that its implications for Canada would likely be minor. Indeed, the study suggested that, with time, Canada would probably be perceived increasingly as part of a North American market in a tripolar financial world. In a similar paper, Crowley (1997) explores some possible developments in the EU over the next decade, tentatively concluding that the direct effect of EMU would likely be an increase in intra-EU trade. In addition, the study noted that EMU could cause a reduction in trade with third-party countries outside the EU.

Updating their 1996 report, the Standing Senate Committee on Foreign Affairs presented a report in 1999 entitled *Europe Revisited: Consequences of Increased European Integration for Canada*. The Committee concluded that the short-term direct impact of EMU would likely be limited. It was also observed that, in the months after the launch of the euro, the Canadian dollar had not been affected by the new currency. The study also suggested that, given Canada's relatively small share of trade with EU members, Canada's trade would likely become more hemispheric in nature. Nevertheless, the report argued that, in the long run, EMU could cause structural reforms in Europe, prompting beneficial trade creation with open-economy partners such as Canada.[10]

The report recommended analyzing a possible Canada-EU free trade agreement, focusing on the implications of tariff elimination. Cameron and Loukine (2001a) explored this issue, concluding that Canada and the EU would both benefit from the elimination of tariffs. In a separate but related paper, Cameron and Loukine (2001b) also examine the implications of EU expansion for Canada. Their results suggest that EU enlargement would not have a large impact on Canada, given the relatively small size of pre-existing trade between Canada and the central and eastern European countries in question. Nevertheless, it is possible that EU accession would cause either trade diversion or trade creation effects for Canada. Empirical assessment of this question, however, will have to await the release of sufficiently long time-series data.

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10. Merchandise trade as a share of GDP has been trending upwards for Canada (from 46 per cent in 1980 to 61 per cent in 2003), a sign of more open trade. This ratio for the EU remained around 28 per cent over the same period.

While adopting a general definition of economic integration, we aim at contributing to the existing literature by documenting the stylized facts and presenting preliminary empirical evidence, using an export share model, regarding the effects on Canada of increased European economic integration.[11] To our knowledge, no other studies have attempted to empirically assess these effects. The few studies mentioned previously that do discuss European economic integration from a Canadian perspective focus primarily on an analysis of the stylized facts.

In general, examination of the stylized facts suggests that, while Canada's trade with the EU continues to rise in levels (in real terms), the EU's share of total Canadian trade has been declining since the 1950s.[12,13] More specifically, while the EU's share of Canadian imports has remained roughly level over this period, the EU's share of Canadian exports has fallen significantly. This decline coincides with a dramatic fall in the relative importance of Canadian non-energy commodity exports to the United Kingdom. In terms of investment, the EU's share has been relatively stable over past decades, while, at the regional level, the investment story is similar to that discussed above for trade flows. Canada's investment in the United Kingdom has declined markedly as a share of total Canadian direct investment in the EU.

What has caused the decline in the EU's share of Canadian exports? Can it be accounted for solely by the fundamental determinants of trade performance, or does Europe's increasing economic integration play a role? Admittedly, the issue of trade creation and trade diversion as a result of

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11. In general, this concept of integration refers to an economic environment where different sectors of an economy or, more generally, different countries work together efficiently and are mutually interdependent. However, other more narrow definitions of the term "economic integration" also exist in the literature. For instance, literature dealing with the theory of customs unions usually defines the term in reference to a reallocation of resources and/or production across countries resulting from the removal of trade restrictions. Such a reallocation is based on each country specializing in the products or lines of production in which it has a comparative advantage. Alternatively, the term may be defined as part of the economic development process. In this framework, financial integration, commercial integration (or customs unions), and real capital market integration are examples of types and stages of economic integration. In this context, monetary integration and common currencies can be interpreted as the highest level of economic integration.

12. Canada's merchandise trade represents 85 per cent of its total trade. We therefore use the term "trade" to refer specifically to merchandise trade. Note also that the EU's share of Canada's total services trade has been declining over the past twenty years.

13. In the analysis of this paper, the term "European Union" refers to the EU15 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom), unless otherwise specified.

Europe's increasing economic integration is best addressed by examining the trend in EU imports within member countries and with other non-EU trading partners. A sophisticated counterfactual experiment would then be necessary to assess the welfare effect of tariff removal. This issue, however, is beyond the scope of our analysis.

Based on a Canadian export share model that controls for relative price competitiveness and relative real income, we find evidence over the 1972–2003 period, consistent with the stylized facts, that increased European economic integration has reduced Canada's relative exports to the EU. This decline can be attributed almost completely to a dramatic fall in the relative importance of Canadian exports to the United Kingdom. Moreover, these findings stand when increased Canada-United States trade is accounted for.

The remainder of this paper is organized as follows. Section 1 describes the major institutional changes that contributed to increased economic integration in the European economy over the past several decades and discusses the evolution of trade relations between Canada and the European Community over the same period. Section 2 reviews the stylized facts regarding the trade and investment relationship between Canada and the European Union. Section 3 provides empirical evidence on the effect of increased European integration on Canada's relative exports to the EU. The final section concludes and suggests areas for future research.

1 Economic Integration in the European Union and Trade Relations with Canada

1.1 The evolution of economic integration in the European Union

Europe's current drive towards economic integration took its first significant step in 1952, only three years after the end of post-World War II reconstruction, when "the Six" (Germany, France, Italy, Belgium, Luxembourg, and the Netherlands) took a critical step in reunifying Europe by establishing the European Coal and Steel Community (ECSC). Five years later, in 1957, the Treaty of Rome was signed, creating the EEC, which, among other things, marked the beginning of the push towards free movement of labour and capital. Indeed, it was in response to the removal of intra-EEC tariff barriers that several other European countries (Austria, Denmark, Norway, Portugal, Sweden, Switzerland, and the United Kingdom) formed the EFTA in 1960. In essence, the goal of the EFTA was to liberalize trade and counterbalance the EEC. In 1967, the ECSC and the EEC (as well as the European Atomic Energy Community) merged to form the EC. Following the establishment of the EFTA and the EC, tariffs on

internal trade within each of these groups were almost entirely removed by the end of the 1960s.

In 1970, the Werner Report laid out, for the first time, the eventual steps to European monetary union. In 1972, "the snake" exchange rate system was introduced, wherein the Six agreed to limit the margin of currency fluctuations to a 4.5 per cent band around an agreed central parity. When the United Kingdom and Denmark left the EFTA and entered the EC along with Ireland in 1973, they also joined the snake. However, this first attempt at European exchange rate coordination fell victim to the effects of the oil-price crises in the late 1970s. By 1978, only five of the nine member states remained on the snake. The mid-1970s had, nonetheless, brought progress on another front. A significant free trade agreement had been reached in 1974 between the EC and the EFTA. Indeed, by the end of the 1970s, virtually all tariff barriers had been removed on the trade of industrial products within Western Europe.

The experience of the snake paved the way for the establishment of the European Monetary System (EMS) in 1979. Within the EMS, the concept of the European Currency Unit (ECU), a virtual currency based on relative gross national product and trade values for all EC countries, was introduced, along with the exchange rate mechanism (ERM). The ERM marked the second attempt at a coordinated EC exchange rate policy and initially included all EC countries except the United Kingdom. Participants in the ERM were originally permitted, like the snake, to move within a 4.5 per cent band around a central parity with the ECU, except for Italy, which adopted a 12 per cent band because of its higher inflation rate.

In 1981, Greece acceded to the EC, followed five years later by Spain and Portugal. In 1987, the original Treaty of Rome was modified by the Single European Act, which formalized, among other things, the plan to create a single European economic market in goods and services, labour, and capital. In addition, the Act included a program for deeper integration within the EC through the removal of non-tariff barriers, the establishment of free labour and production factor flows, and the harmonization of standards by the end of 1992. From this point on, the term European Union was commonly, although informally, used to refer to the EC. In the following years, the ERM expanded to include Spain, the United Kingdom, and Portugal in 1989, 1990, and 1992, respectively, although using the wider 12 per cent band of fluctuation (Italy had, meanwhile, adopted the standard 4.5 per cent band in 1990). Despite several revaluations within the ERM, the mechanism functioned relatively smoothly until 1992, when speculative currency attacks forced the United Kingdom and Italy to withdraw from the arrangement. The following year, a new 30 per cent band was adopted to

provide added flexibility and reduce the threat of speculative attacks. Italy subsequently rejoined the ERM in 1996, whereas the United Kingdom has since abstained.

The formal EU as we know it today came about when the Maastricht Treaty took effect in 1993.[14] Besides enacting a common foreign and security policy and dealing with EU-level matters of justice, this treaty specified the three steps required for economic and monetary union: by the end of 1993, capital flows were to be completely freed within the EU; by 1999, member states preparing to adopt the euro currency upon its launch had to satisfy convergence criteria by which major economic policies were coordinated across nations; at the beginning of 1999, the European Central Bank would be established, along with the official euro currency for which member-country conversion rates were irrevocably set. As of 1999, the EMU was officially established (with the circulation of the common currency following in 2002).[15] The union, marking the final stage of economic integration, according to some, now includes Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. Denmark, Sweden, and the United Kingdom have abstained, to this point, from joining the EMU. More recently, the process of European economic integration continued in May of 2004, when ten central and eastern European countries joined the EU, with plans to adopt the common currency in years to come.[16]

1.2 Canada-European Union trade relations

Canada and the EU maintain a decades-old political and economic relationship. Relations between the two are covered by World Trade Organization (WTO) agreements, as well as by a diversity of bilateral framework and sectoral agreements. More specifically, the economic partnership dates back to 1958, when Canada accredited its first ambassador to the EEC. In 1976, the EEC and Canada signed the historic Framework Agreement for Commercial and Economic Co-operation, the first international agreement between the EEC and an industrialized country. This framework agreement, which called on both parties to develop and diversify their reciprocal commercial exchanges and to foster economic co-

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14. The original member states of the EU were Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and the United Kingdom.

15. The EMU originally consisted of Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. Greece joined later in 2001.

16. Poland, Hungary, the Czech Republic, Estonia, Latvia, Lithuania, Slovakia, Slovenia, Cyprus, and Malta joined the EU on 1 May 2004.

operation, provided for regular dialogue on trade at several levels, and provided the legal basis for further collaboration between the two. Under this agreement, the Joint Cooperation Committee (JCC) was established. This committee meets every year and has a number of subcommittees, including the Trade and Investment Sub-Committee (TISC). Since 1976, as the EEC has evolved into the EU, Canada and the EU have concluded several agreements covering a wide spectrum of economic activities ranging from fisheries and wines and spirits to veterinary issues and nuclear research.[17]

By 1990, there was a desire to build on existing agreements and establish a political framework for Canada-Europe relations. The result was the Transatlantic Declaration on Canada-EU Relations, which set the institutional framework forming the basis for biannual (i.e., twice yearly) summit meetings between the Prime Minister of Canada and his counterpart in the presidency of the EU and the President of the European Commission.[18] The Declaration also established biannual ministerial meetings.

In recognition of the broad nature of common interests, the Canada-EU Action Plan was signed in 1996 to extend co-operation across a wide range of subjects falling under four headings:

- economic and trade relations;
- foreign policy and security issues;
- transnational issues;
- fostering links between the EU and Canada.

Under the umbrella of economic and trade relations, a new EU-Canada trade initiative (ECTI) was launched in 1998, on the eve of the introduction of the euro currency. The ECTI set out priorities for developing bilateral economic relations into the new century. Current issues on the ECTI agenda include: mutual recognition and regulatory co-operation, services, government procurement, intellectual property, competition, business-to-business contacts, cultural co-operation, and electronic commerce. It also includes a commitment to regular and enhanced discussions on multilateral issues.

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17. Several sectoral agreements are in place, including the Agreement on Research in Peaceful Uses of Nuclear Energy (1959); the Agreement on Cooperation in Nuclear Research (1998); the Fisheries Agreement (1981); the Agreement on Science and Technology Cooperation (1995, amended in 1998); the Agreement on Education and Training (1996); the Customs Cooperation Agreement (1997); the Mutual Recognition Agreement (1998); the Veterinary Agreement (1998); the Competition Agreement (1999); and the Agreement on Trade in Wine and Spirit Drinks (2003)

18. The presidency of the EU rotates every six months among the member states.

Also established under this heading was a vehicle for businesses involved in Canada-EU trade to make known their views to the trade ministers on high-level policy issues that have an impact on Canada-EU trade and investment relations. As such, the Canada-Europe Round Table (CERT) was established in 1999.

Under the auspices of ECTI, both the EU and Canada conducted business surveys with a view to assessing the business case for a closer type of Canada-EU economic co-operation. Along with general market factors, the surveys identified regulatory barriers as the main source of difficulties to bilateral trade and investment. From the European perspective, health and safety standards, labelling, packaging, provincial liquor boards, geographical indicators, customs formalities (e.g., the requirement to use 10-digit Harmonized System codes), lack of diploma recognition, and certain restrictions on investment were identified. Many of the same types of difficulties were also identified from the Canadian perspective, in particular, sanitary and technical regulations, packaging, labelling, certification requirements, crop protection rules, and bureaucracy in establishing service companies in the EU.

From these surveys, it was concluded that a new impetus should be given to the bilateral relations through a major political initiative, although a classical free trade negotiation was not necessarily the most appropriate instrument for this purpose. Thus, a new Trade and Investment Enhancement Agreement (TIEA) between Canada and the EU was signed in March 2004. TIEA is intended to be a forward-looking, wide-ranging bilateral trade and investment enhancement agreement covering a new generation of issues and outstanding barriers. In particular, it will tackle the significant impact of regulatory barriers in bilateral trade and investment and pay due consideration to the increasingly prominent role of investment in the bilateral economic relationship.[19]

Although the 1976 framework agreement and subsequent instruments of commercial and economic co-operation have facilitated efforts by both sides to manage and resolve trade and investment disputes, Canada-EU trade and economic relations are so broad that disagreements are almost inevitable. In recent years, trade relations between the two partners have been tainted by long-standing barrier issues for such products as chrysolite asbestos, automobiles, wine, lumber, seafood, beef reared on growth hormones, wheat, and transgenic products like canola. Furthermore, the Canadian government

19. TIEA will address issues such as mutual recognition of professional qualifications, e-commerce, financial services, government procurement, trade and investment facilitation, competition, sustainable development, intellectual property rights, and science and technology co-operation.

believes that the EU's Common Agricultural Policy (CAP), in particular, price support and production subsidies, continues to restrict the access of Canadian agricultural products to the EU while distorting the markets of third-party countries.

2 Stylized Facts

This section summarizes the stylized facts regarding trade between Canada and the EU over the past several decades. The analysis first investigates aggregate trade flows between Canada and the EU, and their major trading partners, before digging deeper to discuss trade between Canada and the individual EU member states. Broad sectoral trade flow data are also examined to assess the Canada-EU trade relationship in more detail. The analysis then examines the evolution of investment between Canada and the EU over the past half century.

2.1 Aggregate trade flows

Canada and the EU maintain important and economically significant trade relations. Total merchandise trade (exports plus imports) between the EU and Canada reached a record level of US$3.6 billion at the end of 2003, having grown almost 86 per cent since the establishment of the EU in the fourth quarter of 1993. Over the same period, however, Canada's trade deficit with the EU increased by almost 250 per cent to a level of US$1.1 billion, implying that Canada is increasingly importing more from the EU than it is exporting.[20]

Although the volume of trade between Canada and the EU continues to grow, it is rising at a slower rate than Canada's trade with other regions of the world. Viewing these trade flows as a share of each area's total trade provides additional context.

2.1.1 The Canadian perspective

From the Canadian perspective, the EU was Canada's second largest trading partner in 2003, after the United States, in terms of both imports and exports. More specifically, the EU accounts for 11.5 per cent of total Canadian imports (versus 59 per cent accounted for by the United States) and 5.3 per cent of total Canadian exports (versus 85 per cent for the United States). These shares, however, have been decreasing. As is evident in

20. Canada has consistently maintained a merchandise trade deficit with EU members since 1984.

Figure A2.1, the EU's share of Canadian imports averaged about 14.5 per cent in the 1960s. This share subsequently fell to about 10 per cent throughout much of the 1980s and 1990s, before rising somewhat to its current level. At the same time, Japan accounted for a growing share of total Canadian imports until the early 1990s, at which time that country entered a protracted economic slowdown. Meanwhile, economic reforms in China and its entry into the WTO have led it to account for a growing share of Canadian imports since the early 1980s, rising from about 0.2 per cent at that time to over 6 per cent at the end of 2003. In terms of individual countries, China is now Canada's second largest import market after the United States. A country-by-country breakdown of Canadian imports from the EU (Figures A2.2 and A2.3) reveals that the composition of imports from the EU has remained largely unchanged since 1980. Note that the share of imports from the United Kingdom has declined from about 30 per cent to about 22 per cent.

On the export side, the EU's share of Canada's exports has declined steadily from about 25 per cent in the 1960s to about 5 per cent since the late 1990s. At the same time, the United States' share has increased notably, from about 60 per cent in 1960 to over 85 per cent at the end of 2003 (Figure A2.4). As Figures A2.5 and A2.6 illustrate, the EU's relative decline was driven primarily by a steep drop in the share of Canadian exports to the United Kingdom. Indeed, as a share of total Canadian exports to the EU, the United Kingdom has fallen from over 85 per cent in the 1950s to about 23 per cent by the mid-1990s.[21] In terms of volume, although Canadian exports to the EU have continued to rise since the 1950s, Figure A2.7 shows that this was not always the case for the United Kingdom. In fact, the volume of Canadian exports to the United Kingdom declined 54 per cent between 1970 and 1985. In contrast, the volume of Canadian exports to the rest of the EU (excluding the United Kingdom) saw a steady upward trend.

These stylized facts are in line with the United Kingdom's increasing economic integration with other European countries over this period. As mentioned, the United Kingdom helped establish the EFTA in 1960. Through the removal of tariffs between the United Kingdom and other EFTA members, Canada now faced increased competition in the British market.[22] Thirteen years later, when the United Kingdom acceded to the EC, Canada faced an even more dramatic shift in competitiveness. In 1960,

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21. Based on available exports data. Time series for exports to some members of the EU are not available before 1986. However, data for the six largest EU countries in terms of Canadian export shares to the EU are available from 1949.

22. For example, Hart (2002) notes that EFTA tariff cuts led Norway to threaten Canada's position as the top supplier of aluminum to Britain.

before the United Kingdom's accession, 97 per cent of Canadian exports to the United Kingdom entered duty-free, compared to about 75 per cent of Canadian exports that entered the EC without tariffs. Moreover, Canada maintained preferential tariff treatment with the United Kingdom on all dutiable goods and 42 per cent of non-dutiable goods, in comparison with goods from the EC. For all other goods, Canada stood on equal footing with the EC countries in terms of UK tariff rates. After the United Kingdom's accession to the EC, Britain shifted its tariffs to match the common EC external tariff rates. This process occurred gradually in five equal steps from 1973 to 1977. As a result, Canada (and other Commonwealth countries) lost all of its preferential tariff treatment with the United Kingdom and in many cases faced reverse preferences compared with other EC countries (Wilgress 1962; Hart 2002).

In stark contrast with the significant decline in the United Kingdom's share of Canadian exports, Figure A2.4 illustrates that the rest of the EU, excluding the United Kingdom, experienced a very modest decline from 1950 to 2003.

Taken together, the steady decline in the EU's share of Canadian exports combined with the relative stability of Canada's share of imports from the EU has left Canada with the aforementioned increasing bilateral trade deficit with the EU over the past forty years.

2.1.2 The European Union perspective

From the EU's perspective, Canada currently ranks eleventh in terms of EU imports (0.7 per cent) and fourteenth in terms of exports (0.8 per cent). As illustrated in Figures A2.8 and A2.9, Canada's share of EU exports fell from about 2 per cent at the beginning of the 1960s to about 0.8 per cent in the early 1980s where it has largely remained since that time. Concurrently, the United States oscillated around 8 per cent of total EU exports, while "Other Asia" and Japan trended upwards until the mid-1990s. China's share of EU exports has been rising since the mid-1980s and appears to be accelerating. At the end of 2003, China's share was over 1.6 per cent of total EU exports, compared to only about 0.5 per cent at the beginning of the 1990s.

In terms of EU imports, Canada's share declined steadily from about 2.6 per cent in the early 1960s to about 0.7 per cent, where it has been since the second half of 1992. On the other hand, the US share of total EU imports declined in the 1960s and again since mid-2001, while Japan's share increased rapidly until the mid-1980s (it has been in decline since the early 1990s). At the same time, the importance of China and "Other Asia" has been trending upwards strongly since the mid-1980s. More recently, China's

share seems to be gaining speed, posting a level of 4.2 per cent, roughly double its value only five years previously. Interestingly, the residual line labelled "Others" in Figures A2.10 and A2.11 makes up roughly twice as much of the EU's total imports as the United States. Since the mid-1990s, growth in this share has been driven by increased trade with the ten central and eastern European countries that acceded to the EU in 2004.[23]

In general, the EU import story mirrors that described above for Canadian exports. The decline in Canada's share of EU imports can be attributed almost completely to a dramatic fall in the relative importance of the United Kingdom's imports from Canada resulting primarily from the United Kingdom's accession to the EFTA (1960) and, later, the EC (1973). However, Figure A2.12 provides additional details. Interestingly, a similar downward trend in the share of UK imports also took place in other Commonwealth countries (e.g., Australia and New Zealand), which, like Canada, lost their preferential trade treatment with the United Kingdom over the 1960s and 1970s.

2.2 Sectoral trade flows

Broad sectoral data provide additional insight into the stylized facts regarding Canada-EU trade. As discussed in the previous section, the EU's share of total Canadian imports has, on the whole, remained fairly stable since the 1960s. The sectoral composition of these imports has remained much as it was twenty years ago (Figure A2.13). Figure A2.14, which disaggregates the commodities sector into energy and non-energy components, shows that the composition of commodity imports has also remained roughly the same since the mid-1980s. Likewise, Figure A2.15 shows little change over this period in the relative importance of the various subsectors that make up the total machinery and equipment sector. In addition, when the major sectors of Canadian imports from the EU are viewed in relation to total Canadian imports from all countries (Figure A2.16), we see that the modest rise in the EU's share of Canadian imports since the 1990s (see section 2.1) was driven primarily by machinery and equipment.

Turning now to Canadian exports to the EU, Figure A2.17 shows that commodities have declined significantly since the 1960s as a share of total Canadian exports to the EU. At the same time, the importance of the machinery and equipment sector has risen while other types of exports have

23. Fuelled by free trade agreements signed in the early to mid-1990s, the ten acceding countries accounted for 12.7 per cent of total extra-euro-zone imports in 2002, up from 4.3 per cent in 1990 (see Anderton, di Mauro, and Moneta 2004, Table 5, p. 21).

remained fairly stable. Looking at a more disaggregated level, Figure A2.18 illustrates that the decline in the importance of the commodity sector was due entirely to non-energy commodities. Similarly, Figure A2.19 shows that the rising importance of the machinery and equipment sector was driven primarily by aircraft products and other residual types of machinery and equipment (the increase in the latter is spread fairly evenly between the miscellaneous machinery and miscellaneous equipment categories). As noted previously, Canada-UK trade plays a pivotal role in the trend of Canadian exports to the EU over the past fifty years. Indeed, the noted decline in Canadian non-energy commodities to the EU was driven primarily by a fall in non-energy commodities to the United Kingdom (Figures A2.20 and A2.21). As noted in Hart (2002), many Canadian non-energy commodity exports to the United Kingdom, such as wheat, barley, aluminum, lead, zinc, and chemicals, faced reverse tariff preferences compared to EC member states following the United Kingdom's accession to the EC in 1973. Such goods had previously held Commonwealth trade preference over other countries.[24] At the same time, Figure A2.22 shows that the decreasing relative importance of commodity exports is evident, not only in exports to the EU, but to all countries in general.[25]

In summary, the stylized facts show that the relative importance of Canada's trade with the EU has, in general, fallen over past decades. While the Canadian share of imports from the EU has remained fairly stable, exports to the EU have declined mainly because of a marked fall in non-energy commodity exports to the United Kingdom. This shift likely resulted primarily from the United Kingdom's accession to the EFTA and, later, the EC, within a context of generally weakening historical ties between Canada and the United Kingdom. A similar downward trend in the share of UK imports also took place in Australia and New Zealand, which, like Canada, lost their preferential trade treatment with the United Kingdom over the 1960s and early 1970s.

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24. Part of the United Kingdom's adoption of common EC external tariffs included the Common Agricultural Policy (CAP), which led the United Kingdom to become more self-sufficient in agricultural goods, while substituting some imports away from countries like Canada and towards other EC member states (Nadeau 1985).

25. Comparative advantage continues to drive a significant portion of Canada's trade, especially in commodity exports. However, the trend towards increasing two-way trade in industrial goods has risen significantly since the mid-1980s. In the machinery and equipment category, for example, the rapidly growing importance of office machines and telecommunications equipment in both exports and imports has fuelled two-way trade. For a review of trends in Canada's merchandise trade, see Dion (2000).

2.3 Investment between Canada and the European Union

For much of its history, Canada has been a net importer of direct investment capital, and this situation has been equally true of the Canada-EU investment relationship. Until 1996, Canadian holdings of direct investment in the EU were always lower than EU holdings in Canada. This situation changed with strong additions to the stock of Canadian direct investment abroad (CDIA) in the EU in 1997 and 1998, and carried through until 1999. The year 2000 was characterized by unprecedented levels of merger and acquisition activity. Canadian direct investment holdings in the EU shot up by 39.7 per cent, while EU holdings in Canada rocketed up by 85.9 per cent, led by France with a 458.5 per cent increase in its foreign direct investment (FDI) holdings in Canada. Notable Canadian firms that were acquired by French investors included Seagram's and Newbridge. The net result was that Canada again found itself in the position of being a net importer of EU direct investment capital at the close of 2000. It was only in 2003 that Canada again reversed the situation and became a net exporter of capital to the EU.

In 2003, Canadians invested just over $14.1 billion in the EU, raising the stock of total Canadian direct investment in the EU to $99.1 billion. At this level, the EU accounted for 24.8 per cent of the stock of total CDIA, second only to the 41.3 per cent invested in the United States. Indeed, Canadian investors have increased their holdings in the EU almost 361 times since the Treaty of Rome came into effect in 1957.[26] By way of comparison, Canadian investment to all countries has grown nearly 182 times since 1957 and CDIA to the United States has grown 107 times over the same period.

On the inward side, the stock of FDI in Canada from the EU stood at $96.7 billion in 2003, some 63.2 times larger than the $1.5 billion level estimated for 1957. Again, this pace has been faster than either that of total FDI in Canada (33.9 times larger in 2003 than in 1957) or that for US FDI in Canada (25.8 times). In 2003, the net flow of direct investment from the EU was $1.5 billion.

More globally, Canada's share of outward direct investment in the EU as a share of total CDIA has risen over the years (Figure A2.23). Until 1956, the EU accounted for less than 10 per cent of the total. In 1957, the EU's share registered 10.2 per cent and climbed to over 19 per cent by 1966. Thereafter, it slowly drifted downwards, falling to 11.4 per cent in 1984. Three years later, Canadian investment activity into the EU began to accelerate, and by

26. Outward and inward direct investment stock data with the EU have been constructed back to 1957 using the available country time series for the EU15 member countries.

1990, the region represented just over one fifth of total CDIA, where it remained for the next dozen years, before jumping to 24.8 per cent of the total in 2003.

As shown in Figure A2.24, on the inward side, the EU's share of total FDI in Canada sat between 15 and 20 per cent until 1986, when it reached 20.3 per cent. It had risen to over 24 per cent by 1990 before sliding back to 20.4 per cent by 1999. The strong European investments made in the year 2000 then pushed the EU's share to just over 30 per cent. The EU's share subsequently receded to about 27 per cent in 2003.

As mentioned in section 1.2, Canadian businesses have experienced regulatory barriers in the EU markets. One way of circumventing these barriers is to establish a domestic presence within the EU market (i.e., CDIA) and sell to that market through a local subsidiary. Unfortunately, there is not much available information on the activities of Canadian foreign affiliates abroad. Only recently has Statistics Canada begun to produce such information, and thus, the data only exist for a limited number of years.

Nonetheless, Table 1 shows that Canadian companies have, in recent years, provided roughly twice as much in goods and services directly via their foreign affiliates in the EU than they have through traditional export channels. Moreover, it seems that the direct sales route is becoming more important, rising to two and a quarter times exports in 2001 from twice the amount of exports only a year earlier.

In terms of regional distribution, investment flows with the United Kingdom are of particular importance. When the United Kingdom joined the EC in 1973, it accounted for 56 per cent of the stock of EU FDI in Canada. Some sixteen years earlier, in 1957, it represented over three quarters of EU investment in Canada; over the next sixteen years, to the end of the 1980s, the United Kingdom more or less maintained its share in the 55 per cent range; since then, its share has been edging downwards and now represents 28 per cent of EU holdings in Canada. Likewise, about 56 per cent of all Canadian direct investment in the EU was placed in the United Kingdom in 1973, down from 84 per cent in 1957, but more than the 41 per cent observed in 2003. These figures represent relative share declines of almost two thirds on the inward investment side and one half for Canadian outward investment between 1957 and 2003. Thus, the overarching story of Canada-EU direct investment relations has been the relative diminishing role of the United Kingdom or, alternatively, the relative increased role of other member countries, notably, France, Germany, and the Netherlands.

On the inward investment side, these three other countries, in addition to the United Kingdom, make up the bulk of EU holdings in Canada. Over 1957–

Table 1
Canada-EU commercial relations:
Exports vs. foreign-affiliated sales

	($ Canadian millions)		
Year	Goods & services exports (1)	Foreign affiliate sales (2)	Ratio (2) as per cent of (1)
1999	29,102	62,000	213
2000	33,843	67,000	198
2001	33,766	77,000	228

Source: Statistics Canada.

2003, these three countries, along with the United Kingdom, accounted for an average of 87.9 per cent of total EU direct investment in Canada, ranging from a low of 81.8 per cent in 1999 to a high of 96.5 per cent in 1989. In 2003, these four countries accounted for 84.1 per cent of all EU FDI in Canada. They are also the only countries to register a greater than 10 per cent share of EU investment in Canada in any of the years between 1957 and 2003.

France first registered a greater than 10 per cent share in 1968 and managed to exceed that threshold over the next dozen years before falling under the mark in 1981. In 1989, France again exceeded the 10 per cent threshold and has continued to do so in every year since. As mentioned earlier, France engaged in some rather sizable merger and acquisition activity in the year 2000 (Figure A2.25). As a result of that activity, France's share of EU holdings jumped to 38.6 per cent in that year from 12.8 per cent the year before. Some of the acquired assets have been sold off in the ensuing years and, as of 2003, France accounted for almost a third (32.7 per cent) of all EU FDI in Canada, or $31.6 billion.

The Netherlands first breeched the 10 per cent threshold over 1965–66, then in 1969–70, and again over 1975–77, and has remained above that level since 1980. In 2003, the Netherlands accounted for 15.8 per cent of total EU FDI in Canada, equivalent to FDI holdings of $15.3 billion.

Germany surpassed the 10 per cent threshold in 1975 and continued to do so until the year 2000 when the sizable additions to total EU holdings (led by the French merger and acquisition activity) caused the German share to fall below the 10 per cent level. At 7.6 per cent of the total EU investment in Canada in 2003, or $7.3 billion, Germany is the smallest of the top four EU investors in Canada.

Turning to the outward investment side, Canadian direct investment into the EU has also been highly concentrated. In terms of preferred investment

locations, Canadian investors have tended to invest in those European countries that have invested most in Canada. That is, much of the Canadian FDI in the EU is situated in Britain, France, Germany, and the Netherlands. Ireland is also a major destination of CDIA in the EU (Figure A2.26).

With 40.1 per cent of the total, or $40.7 billion, the United Kingdom remains the largest recipient of CDIA in the EU, followed by Ireland (18.4 per cent, or $18.2 billion), France (11.7 per cent, or $11.6 billion), the Netherlands (10.8 per cent, or $10.7 billion), and Germany (7.9 per cent, or $7.8 billion). Together, these five countries accounted for, on average, about 88.8 per cent of total CDIA in the EU over 1957–2003. In 2003, these countries contributed 89.8 per cent of the total, and their collective shares have ranged from 86.1 per cent (in 1976) to 96.4 per cent (in 1957).

Excluding investment in the United Kingdom, Canadian investors have not often placed more than 10 per cent of their holdings of CDIA in the EU in other European countries. CDIA in France exceeded this 10 per cent threshold between 1974 and 1976 and again over 1988–89. With the acquisition of the French firm Pechiney by Alcan in December of 2003, the stock of Canadian investment in France grew 156.4 per cent in 2003, to $11.6 billion, or 11.7 per cent of total CDIA in the EU.

Ireland has captured more than 10 per cent of CDIA in the EU since 1993 (except for the year 2000), while the Netherlands has accounted for over 10 per cent since 1998. Germany, lone among the top five destinations for Canadian FDI in the EU, is the only nation in this group not to have surpassed the 10 per cent threshold at least once.

In summary, although Canada-UK investment levels have risen in absolute terms, they have not kept pace with those between Canada and the other EU member nations over 1957–2003; this explains the broad movement in shares over this period. Thus, there appears to have been a limited shift in the focus of Canada-EU investment relations away from the United Kingdom and, particularly, towards France, the Netherlands, Germany, and perhaps, Ireland.

3 Canadian Export Share Model

Assessing the impact of increased European integration on trade with Canada is an empirically difficult exercise given the complexity of modelling economic integration. We attempt to address the issue with a simple export share model, using a panel data set based on country-pair observa-

tions between Canada and each of the EU countries.[27,28] We would like to stress that the scope of our empirical analysis is limited to explaining the stylized facts regarding Canadian exports to EU member countries as presented in the previous section. Thus, our analysis does not attempt to account for movement in the EU's share of Canadian imports, given that this variable is driven by Canadian domestic factors that are unrelated to the issue of increased European economic integration.

As discussed previously, overall trade between Canada and the EU has fallen as a share of each area's total trade. What has caused the decline in these shares? Can they be accounted for solely by the fundamental determinants of trade performance, or does Europe's increasing economic integration also play a role? In this section, we investigate the factors contributing to the overall decline in Canadian exports to the EU as a share of total Canadian exports. To this end, a theoretically based reduced-form export share model is developed by combining both supply and demand determinants of export performance, such as relative price competitiveness and relative foreign real income. By specifying our model in relative terms (i.e., shares), we implicitly account for the general increase in world trade openness.[29] Linear time trend and dummy variables are then added to the basic model to capture excess trade resulting from other factors, such as increased European economic integration.

In developing our model, we proceed in two steps. We first specify Canadian exports to the individual EU member countries, as well as total Canadian exports to all countries, using the aforementioned fundamental determinants. Thus, defining Canada as country i, equations (1) and (2) specify Canadian real exports to country j and total Canadian real exports, respectively. In step two, the export share equation is then obtained by dividing equation (1) by equation (2), the results of which are given as equation (3).[30]

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27. All data are taken from Statistics Canada, the Organisation for Economic Co-operation (OECD) (2004), the Bank for International Settlements (BIS), and the International Monetary Fund (IMF) databases. All foreign variables were converted to Canadian dollars. Constant dollar and price index series were rebased to 2000 as the reference year, in cases where base years were different. Mnemonics are described in Appendix 1.

28. Based on data availability, the term "European Union" refers throughout our empirical analysis to the fourteen members of the EU (before the May 2004 expansion) excluding Luxembourg, unless otherwise noted.

29. Ideally, we would also like to explain the level of Canadian real exports to EU countries as well as the level of Canadian real exports to the world. However, we did not find evidence of cointegration in level terms, using both the panel Johansen cointegration test and within a panel error-correction model. Thus, we could not make valid empirical inferences.

30. Estimating the export share model as specified in equation (3) implicitly imposes the following restrictions: $\beta_0 = \alpha_{10}/\alpha_{20}$, $\beta_1 = \alpha_{11}/\alpha_{21}$, and $\beta_2 = \alpha_{12}/\alpha_{22}$.

$$X_{ijt}/PX_{it} = \alpha_{10} + \alpha_{11}(P_{it}/P_{jt})^{*}ner_{jit} + \alpha_{12}Y_{jt}/ner_{jit} + \varepsilon_{ijt}, \quad (1)$$

$$X_{it}/PX_{it} = \alpha_{20} + \alpha_{21}(P_{it}/P_{wt})^{*}neer_{it} + \alpha_{22}Y_{wt}/neer_{it} + \varepsilon_{it}, \quad (2)$$

$$X_{ijt}/X_{it} = \beta_0 + \beta_1(P_{wt}/P_{jt})^{*}(ner_{jit}/neer_{it}) + \beta_2(Y_{jt}/ner_{jit})/(Y_{wt}/neer_{it}) + \varepsilon_{xijt}, \quad (3)$$

where the variables are defined as:

X_{ijt}: Canadian exports to country j at time t; X_{it}: total Canadian exports; PX_{it}: the Canadian export price deflator; X_{ijt}/PX_{it}: Canadian real exports to country j; X_{it}/PX_{it}: total Canadian real exports; $Y_{(i \text{ or } j \text{ or } w)t}$: real GDP in country i or j or in the world; P_{it}: the GDP price deflator in country i; P_{jt}: the GDP price deflator in country j; P_{wt}: the world price deflator; ner_{jit}: the nominal exchange rate between country j and i (where an increase corresponds to an appreciation of currency i versus currency j); $neer_{it}$: the nominal effective Canadian exchange rate (an increase is an appreciation of the Canadian dollar); and ε_{ijt}, ε_{it}, and ε_{xijt} are random error terms.

Looking further at equation (1), X_{ijt}/PX_{it} denotes real exports from Canada to country j at time t. The export performance of Canada with respect to country j depends primarily on its price competitiveness relative to country j as measured by its real bilateral exchange rate, $(P_{it}/P_{jt})^{*}ner_{jit}$, and also on the Canadian dollar level of real income in country j, denoted Y_{jt}/ner_{jit}.

In equation (2), X_{it}/PX_{it} denotes total Canadian real exports to the world at time t. In this traditional export equation, Canada's export performance is expected to depend primarily on its relative price competitiveness versus all trading partners, in addition to the level of world demand. Relative price competitiveness is captured by the price of Canada's goods, P_{it}, relative to the price of world goods, P_{wt}, expressed in Canadian dollars using the nominal effective exchange rate for Canada, denoted $(P_{it}/P_{wt})^{*}neer_{it}$. The level of world demand (or world real GDP) is expressed in Canadian dollars and is denoted $Y_{wt}/neer_{it}$.[31] The latter specifies shifts in world demand for Canada's export goods.

Finally, expressing Canadian real exports to country j as a share of total Canadian real exports yields the export share function as represented by equation (3). This export share is expected to depend on the ratio of relative price competitiveness, denoted $(P_{wt}/P_{jt})^{*}(ner_{jit}/neer_{it})$, in addition to the

31. World real GDP is defined in US dollars and converted to Canadian dollars using the nominal bilateral Canada-US exchange rate.

relative real income of country j as a share of world real income, $(Y_{jt}/ner_{jt})/(Y_{wt}/neer_{jt})$.[32]

Empirical estimation of the export share equation (equation (3)) uses a panel data set covering 14 country pairs (i.e., exports from Canada to each of the EU15 countries, excluding Luxembourg owing to data availability).[33] The data are of a quarterly frequency and include the period from 1986 to 2003.[34] The estimated long-run parameters are obtained using the panel dynamic ordinary least squares (DOLS) leads-and-lags procedure, which corrects for potential endogeneity bias (Kao and Chiang 2000; Mark and Sul 2002).[35] These estimates are derived with four leads and four lags on the first difference of the two fundamental determinants. Note that our results are robust when the lag process is reduced from fourth order to second order. Table 2 presents the panel estimation results for Canadian exports to the EU as a share of total Canadian exports.

Overall, our base-case results (equation (3) reported in column (1)) for the Canadian export share equation suggest that relative real income accounts for about 57 per cent of the long-run movement in the Canadian export volume to the EU as a share of total Canadian exports. Furthermore, the estimated parameter associated with EU income relative to world income takes the expected positive sign and is statistically significant. On the other hand, the estimated parameter on the relative real exchange rate is not statistically significant.

In column (2) of Table 2, after controlling for relative price competitiveness and relative real income, the base-case equation is augmented with a linear time trend over the entire estimation sample period to help account for the trend decline in the EU's share of Canadian exports not accounted for by movements in its long-run determinants (see column (2)). Because our model is specified in terms of shares, the general increase in world trade

32. Admittedly, the foreign price deflator of country j at time t should be measured by the domestic price deflator of country j at time t (price of domestic substitutes). For reasons of data availability, however, we use the GDP price deflator for each country in the calculation of the relative bilateral real exchange rate.

33. All panel estimations and statistical tests were performed using the Stata and Eviews packages.

34. Although it is theoretically inappropriate for a bounded variable such as a share to be truly non-stationary, it may nevertheless be so, in a statistical sense, over a given sample period. This is the case for several of our share variables over our sample period. Indeed, we find evidence of a unit root in the level of all relevant variables, based on the Hadri panel stationarity test.

35. We test for cointegration using the panel Johansen cointegration test and through a panel error-correction model using the Granger representation theorem (1987). In both cases, we reject the null of no cointegration, thus allowing valid inferences.

Table 2
Canadian export share equation (1986–2003)

Panel estimations,[a] Canada and 14 EU countries, sample: 1986Q1–2003Q4, N = 1008				
	Dependent variable: X_{ij}/X_{it}			
Long-run factors	**(1)**	**(2)**	**(3)**	**(4)**
Constant	−0.008	−0.005	0.007	0.007
	(0.97)	(0.53)	(1.47)	(1.53)
Relative bilateral real exchange rate[b] $(P_{wj}/P_{ji})^{*}(ner_{ji}/neer_{ij})$	0.009	0.009	−0.001	−0.003
	(1.13)	(1.01)	(0.38)	(1.07)
Relative income of country j as a ratio to world income $(Y_{ji}/ner_{ji})/(Y_{wj}/neer_{ij})$	0.159	0.157	0.117	0.116
	(4.65)**	(4.46)**	(6.99)**	(6.84)**
EU trend		−0.00002	−0.00004	
		(1.16)	(2.12)*	
UK dummy			0.011	0.031
			(15.43)***	(17.44)***
UK trend				−0.0002
				(13.87)***
EU trend (ex-UK)				−0.00003
				(1.94)
RBAR[2]	0.5701	0.5735	0.7793	0.8109

a. The panel DOLS estimation procedure uses four leads and four lags. The estimated parameters of the first-difference terms are constrained to be the same across countries (i.e., homogeneous dynamics). White heteroscedasticity-consistent errors are used in the calculation of the t-statistics (in parentheses). * (**) (***) denote that the parameter is statistically different from zero at a 10 per cent (5 per cent) (1 per cent) level. Critical values are from the standard distribution. See Kao and Chiang (2000) for a discussion of the properties of panel DOLS.
b. + (−) appreciation (depreciation) of the Canadian dollar

openness is implicitly accounted for. After controlling for fundamental determinants, our trend variable, therefore, captures excess trade resulting from other factors, such as increased European economic integration. Although of the expected negative sign, the estimated parameter associated with the EU trend is not statistically significant.

Reflecting the extraordinarily strong historical trade relationship between Canada and the United Kingdom, we are interested in determining whether the inclusion of a UK dummy variable would significantly change our results. We therefore re-estimate our panel regressions over the same sample period, including a dummy variable that takes a value of one only for Canada-UK country-pair observations and zero otherwise. The results, reported in column (3) of Table 2, show that including a dummy variable for the United Kingdom's share of Canadian exports does indeed significantly increase the explanatory power of the estimated equation (from 0.57 to 0.78). As expected, the estimated parameter associated with the UK dummy

variable takes a positive value, reflecting larger Canadian exports to the United Kingdom, on average over our sample, as a share of total Canadian exports. At the same time, the estimated parameter on relative real income falls modestly, while the estimated parameter on the relative real exchange rate remains statistically insignificant.[36]

As discussed in section 2, the relative importance of Canada's exports to the EU has been driven primarily by a marked fall in non-energy commodity exports to the United Kingdom (Figures A2.4 and A2.6). Given this dramatic fall in exports to the United Kingdom as a share of total Canadian exports, we re-estimate our panel regressions over the same sample period, including a UK-specific linear time trend variable along with a separate trend for exports to all the other EU countries (i.e., excluding the United Kingdom). The results, reported in column (4) of Table 2, show that including a distinct UK linear time trend variable and another for the other EU countries (denoted EU ex-UK) increases the explanatory power of the estimated equation (from 0.78 to 0.81). More importantly, the estimated parameter on the UK trend is ten times that of the EU ex-UK trend variable consistent with the stylized facts reported earlier.

As mentioned previously, the dramatic fall in the United Kingdom's share of Canadian exports began in the early 1950s (based on available data). The estimation results reported in Table 2 cover the period from 1986 to 2003. By removing three country pairs from the sample (i.e., Canadian exports to Greece, Spain, and Portugal), we are able to extend the sample period to cover 1972 to 2003. This longer sample helps to more fully incorporate the large and gradual fall in exports to the United Kingdom as a share of total Canadian exports. The results of this exercise, reported in Table 3, reveal that extending our sample period back to 1972 effectively doubles the estimated parameter on both the UK dummy variable and the UK-specific linear time trend, while the estimated parameters on the other explanatory variables remain broadly unchanged. The only exception is the estimated parameter on the relative real exchange rate, which takes the expected negative sign and is statistically significant when the UK dummy variable and the two trend variables are also included.

In summary, while fundamental trade determinants (i.e., relative price competitiveness and relative real income over the period) explain, in part, the EU's declining share of Canadian exports over the period, the characteristics of Canada-UK trade, in particular, also played an important

36. When dummy variables for other major country pairs (e.g., Canadian exports to Germany, France, and the Netherlands) are included in the regression, the estimated parameter for the Canada-UK dummy variable dominates in size.

role. A dummy variable for the Canada-UK country pair takes a relatively large positive parameter, indicative of the United Kingdom's relatively strong trade ties with Canada. In addition, a linear time trend for the same country pair takes a negative and highly statistically significant estimated parameter, reflecting the dramatic decline in the United Kingdom's share of Canadian exports. At the same time, a single trend variable included for all other EU countries (excluding the United Kingdom) takes a smaller, but still statistically significant, negative parameter. More importantly, the estimated parameter on the UK trend is roughly ten times that of the EU ex-UK trend variable. This is consistent with the fact that Canada's exports to the EU, excluding the United Kingdom, only trended downwards very modestly over the period.

These empirical results are further substantiated by narrowing our sample down to six countries (Belgium, France, Germany, Italy, the Netherlands, and the United Kingdom) for which data are available from 1960 to 2003. This sample period allows us to fully cover the United Kingdom's membership in the EFTA and the EC up until 2003. The results of this exercise, which are available upon request, effectively double the estimated parameter on both the UK dummy variable and the UK-specific linear time trend, while the estimated parameter associated with the EU ex-UK trend variable remains unchanged when compared to the results reported in column (4) of Table 3. At the same time, the estimated parameters on the other explanatory variables are reduced roughly by half. Hence, these results provide additional evidence that the decline in the EU's share of Canadian exports was driven largely by the United Kingdom's increased economic integration with Western Europe during the 1960s and 1970s.

To capture the effects resulting from changes in the relative tariff rate on the EU's share of Canadian exports, we included data on relative tariff rates charged by the EU and the United States on imports from Canada. Taking the ratio of the EU tariff rate to that of the United States, we use the US rate as a proxy for the average world tariff rate (recall that the United States comprises 80 to 85 per cent of Canada's exports over this period). This tariff ratio was added to the specification in column (4) of Table 3. However, our results show that the estimated parameter on the tariff ratio, although of the expected negative sign, was not statistically significant. Nonetheless, this result does not imply that tariff changes have had no impact on Canada-EU trade patterns. Our tariff data begin only in 1988 and, thus, may not adequately capture the steep decline in the United Kingdom's share of Canadian exports since the early 1970s.[37] At the same time, Clausing (2001)

37. As an alternative, the ratio of the UK tariff rate to the US tariff rate may better reflect the shift in tariff rates that most affected Canada.

Table 3
Canadian export share equation (1972–2003)

Panel estimations,[a] Canada and 11 EU countries, sample: 1972Q1–2003Q4, N = 1408					
	Dependent variable: X_{ct}/X_{tt}				
Long-run factors	**(1)**	**(2)**	**(3)**	**(4)**	**(5) Excluding the US**
Constant	−0.013	−0.011	0.009	0.014	0.049
	(1.09)	(0.70)	(1.19)	(2.29)*	(2.03)*
Relative bilateral real exchange rate[b] $(P_{cc}/P_{jt})^{\alpha}(nxr_{jt}/nxr_{ct})$	0.016	0.015	−0.002	−0.008	−0.049
	(1.29)	(1.03)	(0.30)	(2.16)*	(2.33)*
Relative income of country j as a ratio to world income: $(Y_{jt}/nxr_{jt})/(Y_{wt}/nxr_{ct})$	0.165	0.164	0.119	0.113	0.303
	(3.19)**	(3.08)**	(3.84)**	(4.40)**	(4.37)**
EU trend		−0.00001	−0.000005		
		(0.42)	(2.49)*		
UK dummy			0.019	0.050	0.142
			(8.35)**	(22.22)***	(12.72)***
UK trend				−0.0004	−0.0006
				(16.34)***	(9.05)**
EU trend (ex-UK)				−0.000004	0.000007
				(2.41)*	(2.84)*
RBAR^2	0.4473	0.4483	0.7027	0.8421	0.8209

a. The panel DOLS estimation procedure uses four leads and four lags. The estimated parameters of the first-difference terms are constrained to be the same across countries (i.e., homogeneous dynamics). White heteroscedasticity-consistent errors are used in the calculation of the t-statistics (in parentheses). * (**) (***) denote that the parameter is statistically different from zero at a 10 per cent (5 per cent) (1 per cent) level. Critical values are from the standard distribution. See Kao and Chiang (2000) for a discussion of the properties of panel DOLS.
b. + (−) appreciation (depreciation) of the Canadian dollar.

argues that the use of highly aggregated data to estimate the effects of integration does not allow one to exploit the variation in tariff rates that occur at the commodity level. Thus, in our empirical work, our dummy and linear time trend variables likely capture the effect from changes in tariff and non-tariff barriers.

Returning to our 1972–2003 sample, Figure A2.27 illustrates the relationship between the EU's share of Canadian exports and the two fundamental determinants used in our export share model, namely, the EU's share of world real income and the real bilateral exchange rate as a share of Canada's real effective exchange rate. Alone, these two factors explain about 45 per cent of the variance in the EU's share of Canadian exports (see column (1) of Table 3). The graphic representation in Figure A2.27 reveals the expected co-movement between the two fundamental determinants and the EU's share of Canadian exports. This co-movement appears less certain after

about 1990. Overall, part of the general trend decline in the EU's share of Canadian exports appears to be consistent with a gradual trend decline in the EU's income share, which falls by about half over the period shown in Figure A2.27. In addition, periods of notable strength in the EU's income share (e.g., late 1970s and late 1980s) correspond to intervals of growing relative Canadian exports to the EU. Likewise, when the EU's share of world income falls significantly (e.g., in the early 1980s), Canadian exports to the EU generally decline as a share of Canada's total exports.

At the same time, a clear negative relationship is visible between the relative real exchange rate (where a higher value corresponds to a relative appreciation of the Canadian dollar) and the EU's share of Canadian exports. When the Canadian dollar appreciates strongly versus the EU currencies (relative to the Canadian effective exchange rate), exports to the EU fall as a share of total Canadian exports (e.g., early 1980s). On the other hand, when the Canadian dollar depreciates versus the EU currencies in relative terms, the EU's share of Canadian exports grows (e.g., around 1980, and the mid- to late 1980s).

Despite these facts, it also appears that a portion of the general downward trend in the EU's share of Canadian exports over the 1972 to 2003 period cannot be accounted for by these two fundamental factors. The stylized facts and empirical results presented above suggest that much of this downward trend is attributable to the relative decline in Canada's exports to the United Kingdom. Indeed, when the United Kingdom is excluded, Canadian exports to the rest of the EU, as a share of total Canadian exports, appear to follow the fundamental determinants more closely (Figure A2.27). Accordingly, the UK dummy variable and UK trend included in our empirical specifications explain roughly half of the adjusted R^2 (0.8421) estimated by our export share model over the 1972 to 2003 period. When Britain co-founded the EFTA in 1960 and then acceded to the EC in 1973, it removed trade barriers between itself and the rest of Western Europe. This shift in trade policy occurred within a context of generally weakening historical ties between Canada and Britain. Indeed, like Canada, Australia and New Zealand lost their preferential trade treatment with the United Kingdom over the 1960s and early 1970s. As such, the story is one of increasing economic integration between the UK and the EC, at the expense of Britain's former colonies.

It is important, however, to keep in mind that Canada was making strides to strengthen its trade ties with the United States over the same period by signing the bilateral Auto Pact in 1965. More recently, North American economic integration increased significantly with the advent of the Canada-US Free Trade Agreement in 1989 and the subsequent signing of the North

American Free Trade Agreement (NAFTA) in 1994. Indeed, as reported in the section on stylized facts, the US share of Canadian exports has substantially increased over the past fifty years. This increase in the US share may have contributed to the decline in the EU's share of Canadian exports over the same period.

To empirically analyze this issue, we re-estimate our panel regression of column (4) in Table 3 over the 1972 to 2003 sample period, but we exclude Canadian exports to the United States in our calculation of total Canadian exports. The results, reported in column (5), show that excluding Canadian exports to the US increases the estimated parameters on all the variables, including a significant increase in the UK dummy (three times larger). More importantly, the estimated parameter on the EU ex-UK trend variable now takes on a significant small positive value consistent with our main conclusion that, excluding the United Kingdom, the EU's share of Canadian exports has remained relatively unchanged over the past fifty years.

Conclusion

This paper has examined the effects of increasing European economic integration on the EU's trade with Canada over the past fifty years.

In broad terms, the stylized facts suggest that, while Canada's trade with the EU continues to rise in terms of levels (export and import volumes), the EU's share of total Canadian trade has been declining since the 1950s. More specifically, while the EU's share of Canadian imports has remained roughly level over this period, the EU's share of Canadian exports has fallen significantly. This decline can be attributed almost completely to a dramatic fall in the relative importance of Canadian non-energy commodity exports to the United Kingdom. This shift in UK imports was likely driven primarily by Britain's co-founding of the EFTA in 1960 as well as that country's accession to the EC in 1973, which left Canada (and other Commonwealth countries, such as Australia and New Zealand) without its pre-existing preferential trade treatment. At the same time, increased North American economic integration has further boosted the United States' dominance as Canada's primary export market.

In terms of investment, the EU has been relatively stable over past decades, both as a share of total Canadian investment abroad and as a share of total foreign investment in Canada, although the latter has declined modestly. At the regional level, the investment story is similar to that discussed above for trade flows, namely, the United Kingdom's share of total Canadian direct investment in the EU has fallen dramatically, as has its share of total EU investment in Canada. Since the signing of the Treaty of Rome in 1957,

these shares have fallen by at least half, with Canada investing relatively more in Ireland and the Netherlands, while, on the flip side, France and the Netherlands are investing relatively more in Canada.

To empirically analyze these stylized facts, the study uses a quarterly panel data set of trade between Canada and fifteen EU countries. Estimates based on an export share model (over the 1986–2003, 1972–2003, and 1960–2003 periods) provide evidence consistent with the idea that increased European economic integration may have helped reduce Canada's relative exports to the EU, and most notably, to the United Kingdom. More specifically, while fundamental trade determinants (i.e., relative price competitiveness and relative real income over the period) explain about half of the EU's declining share of Canadian exports over the period, the United Kingdom, in particular, also played a separate, but important, role (roughly explaining the other half). A dummy variable for the Canada-UK country pair takes a relatively large positive parameter, indicative of the United Kingdom's comparatively strong trade ties with Canada. In addition, a linear trend for the United Kingdom takes a negative and highly statistically significant estimated parameter, reflecting the United Kingdom's gradually declining relative importance in terms of Canada's exports. At the same time, a single trend variable included for all other EU countries (excluding the United Kingdom) takes a very small statistically significant negative parameter. This result is consistent with the fact that Canada's exports to the EU, excluding the United Kingdom, only gradually trended downward over the period.

Clearly, the evolution of Canada-UK trade has been an important influence in this downward trend. Within the context of generally weakening historical ties between the two countries, evidence suggests that the United Kingdom's declining importance to Canadian exports was caused primarily by its increased economic integration with Western Europe, as mentioned previously. As a result of this process of integration, Canada lost its preferential trade treatment by the United Kingdom. However, at the same time, the EU's share of Canadian exports may also have been affected by increased Canada-US economic integration (e.g., the 1965 Canada-US Auto Pact, the 1989 Canada-US Free Trade Agreement, and the 1994 North American Free Trade Agreement). To the extent that these factors increased Canadian exports to the United States, they would also reduce the EU's relative export importance. Our results suggest that, when increased Canada-US trade is accounted for, however, Canada's export share to the EU, excluding the United Kingdom, has been stable over the past fifty years, while that of the United Kingdom has trended downward.

In summary, our analysis suggests that while increased European economic integration does not appear to have resulted in a decline in the general EU-wide trade with Canada since the 1950s, it has nevertheless played a very significant role with regard to Canada's exports to the United Kingdom. Indeed, given that a similar decline occurred in the former British colonies of Australia and New Zealand, evidence suggests that the majority of the decline in Canada's relative exports to the EU was caused by the United Kingdom's growing economic integration with the rest of Europe. In the end, it appears that there was some validity to the concern expressed by L.D. Wilgress in 1962 (as quoted at the beginning of this paper), at least in terms of export shares. Indeed, the loss of Canada's former preferential trade treatment under the British Commonwealth proved to be an important factor in this respect.

Looking towards future research, the empirical analysis of this paper could be extended to use a larger sample of country pairs, subsuming the indirect effect on Canada-EU trade caused by bilateral trade with and between other countries (e.g., intra-EU trade; extra-EU trade with countries such as the United States, Japan, Switzerland, and China). As a result, such an expanded model would better capture the effect of increased European economic integration, while controlling for other factors such as increased North American economic integration and the recent favourable supply-side developments in China. As shown in the section on stylized facts, EU trade with Asia has been on the rise, especially with China. Indeed, the increase in relative price competitiveness resulting from favourable supply-side developments in China contribute, other things being equal, to increased trade with that country, while possibly reducing trade with other trading partners. These facts draw attention to the importance of accounting for any significant change in extra-European trade patterns resulting from factors unrelated to European integration.

Dependent on available data, future research could also account for EU trade with the ten new EU member states. Indeed, although significant trade agreements were reached in the early 1990s between the EU15 and the ten future members, their accession to the EU in May of 2004 marked another large step towards European economic integration.

Appendix 1
Data Description

This appendix describes the data mnemonics used in this paper. Data are taken from Statistics Canada, OECD (2004), BIS, and IMF databases.[1] All time-series mnemonics consist of an "economic variable" component, as shown in the table below. Each mnemonic also contains a second component that denotes the country.

Mnemonic	Description
	Economic variable component
M<country>	Value of merchandise imports
ner<j><i>	Nominal bilateral exchange rate between country *j* and *i* (+: appreciation of currency *i* versus currency *j*), expressed as an index (2000 = 100)
neer<i>	Nominal effective exchange rate of country *i* (+: appreciation of currency *i* versus its main trading partners), expressed as an index (2000 = 100)
P<country>	GDP price deflator (2000 = 100)
PC<country>	Consumer price index (2000 = 100)
PM<country>	Goods import price deflator (2000 = 100)
PX<country>	Goods export price deflator (2000 = 100)
Pw	World price deflator (2000 = 100)
X<country>	Value of merchandise exports
Y<country>	Real GDP
Yw	World real GDP
	<Country> component
EMU countries	Austria (*aut*), Belgium (*belg*), Finland (*fin*), France (*fr*), Germany (*ger*), Greece (*gr*), Ireland (*ire*), Italy (*it*), Luxembourg (*lux*), the Netherlands (*neth*), Portugal (*pt*), Spain (*sp*)
EU countries	EMU countries plus Denmark (*dnk*), Sweden (*swed*), United Kingdom (*uk*)
Other countries	Canada (*ca*), China (*china*), Japan (*jpn*), Switzerland (*swit*), United States (*us*)

1. Any Canadian statistics taken from OECD (2004) were originally collected by Statistics Canada and supplied to the OECD.

Appendix 2
Figures

Figure A2.1
Canadian imports by country (share of total Canadian imports)

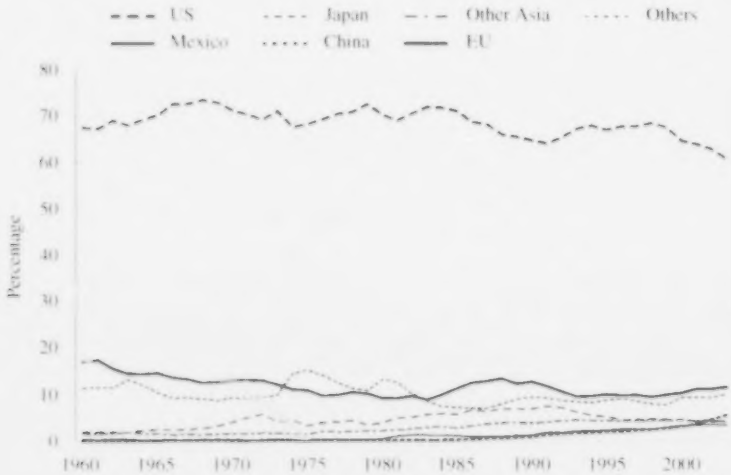


Figure A2.2
Canadian imports from individual EU countries (share of total Canadian imports from the EU)

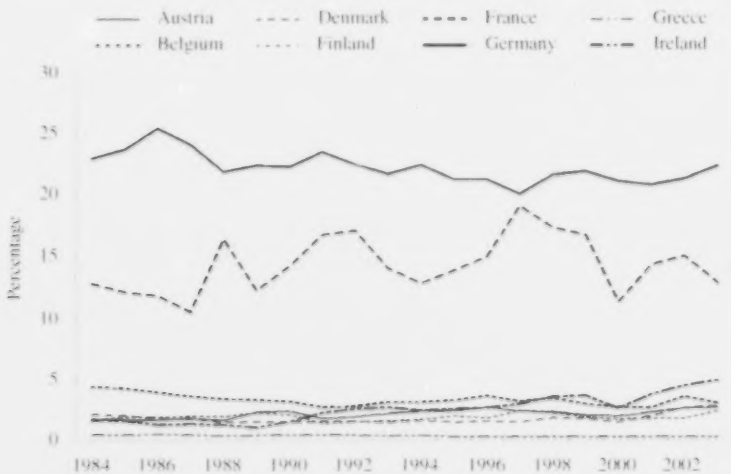


Figure A2.3
Canadian imports from individual EU countries
(share of total Canadian imports from the EU)

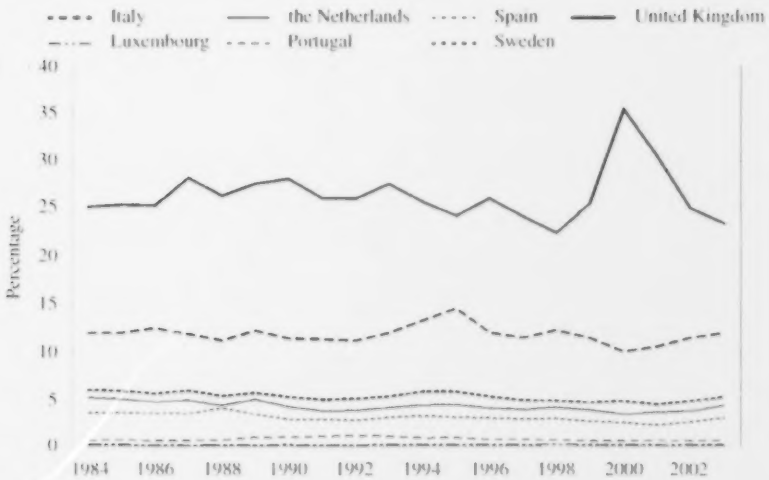


Figure A2.4
Canadian exports by country
(share of total Canadian exports)

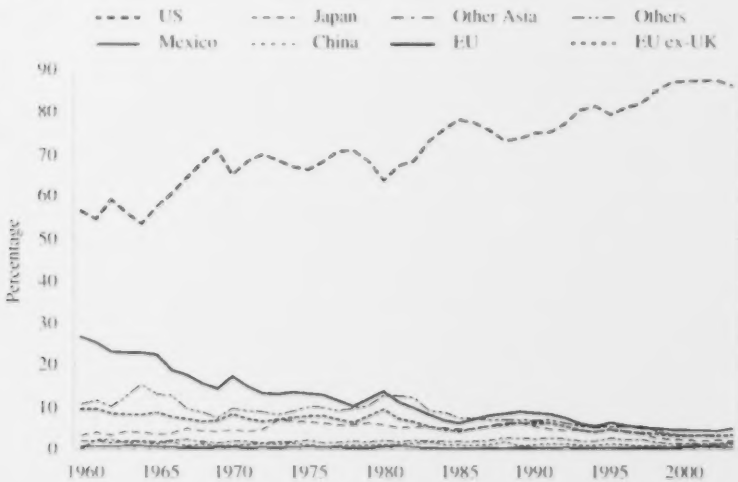


Figure A2.5
Canadian exports to individual EU countries
(share of total Canadian exports to the EU)

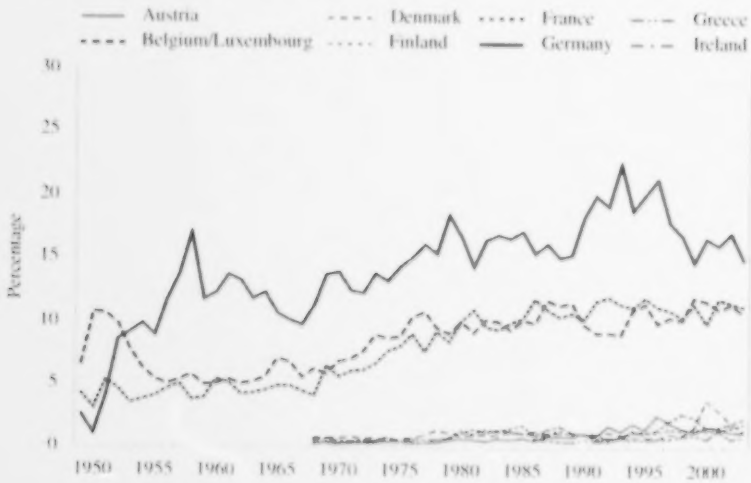


Figure A2.6
Canadian exports to individual EU countries
(share of total Canadian exports to the EU)

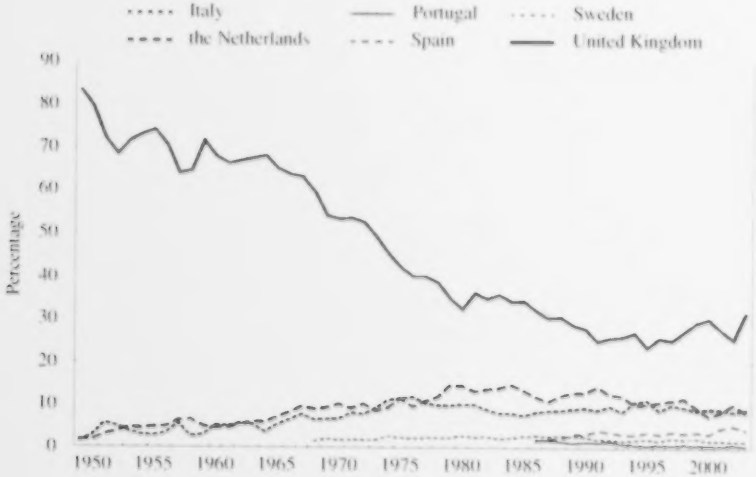


Figure A2.7
Canadian exports to the EU (volume)

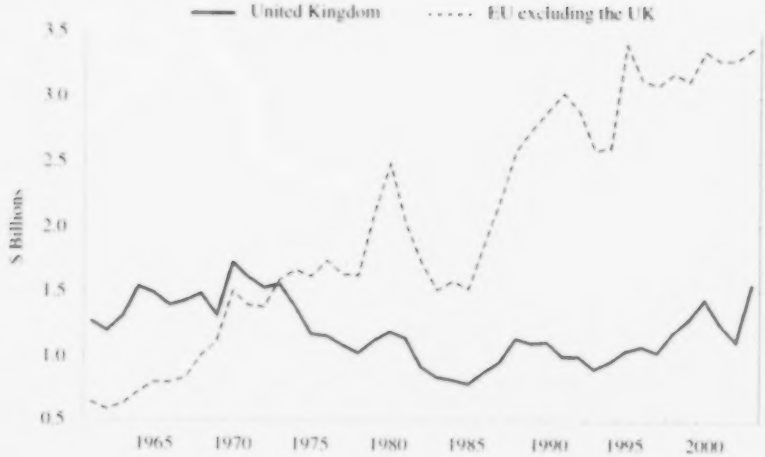


Figure A2.8
EU exports by country
(share of total EU exports)

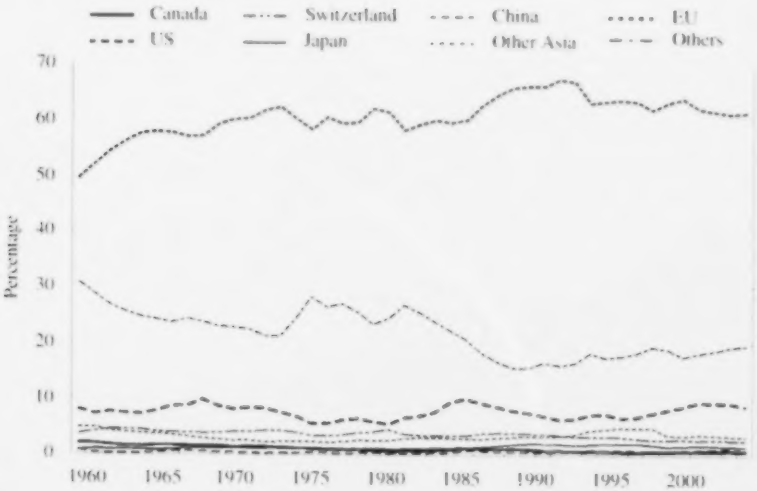


Figure A2.9
EU exports by country
(share of total EU exports)

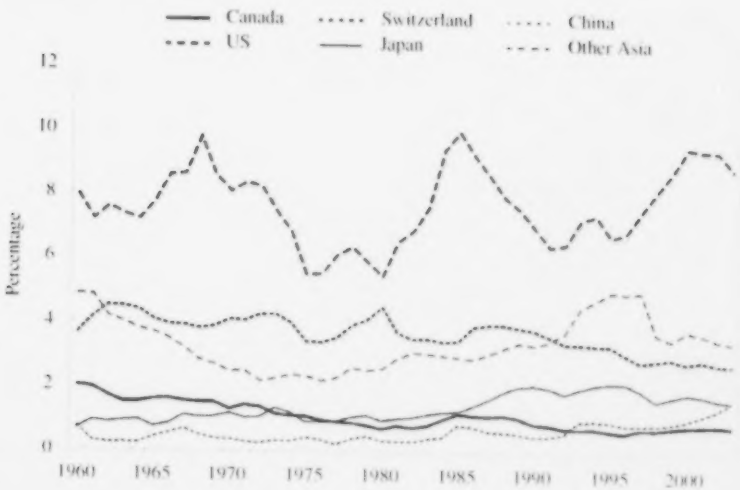


Figure A2.10
EU imports by country
(share of total EU imports)

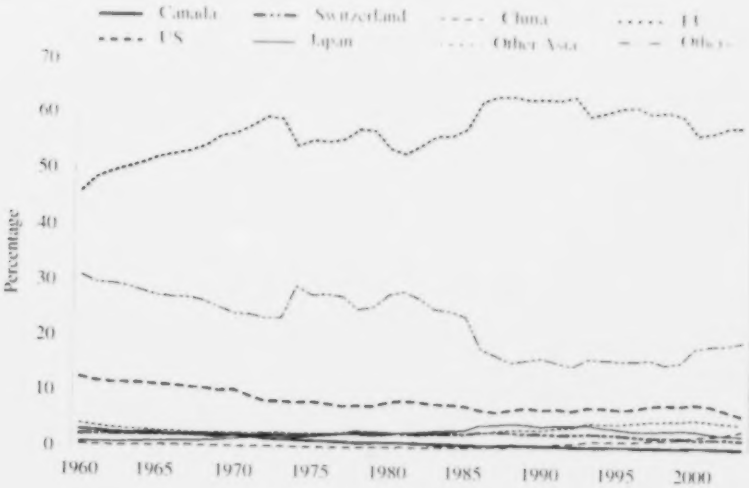


Figure A2.11
EU imports by country
(share of total EU imports)

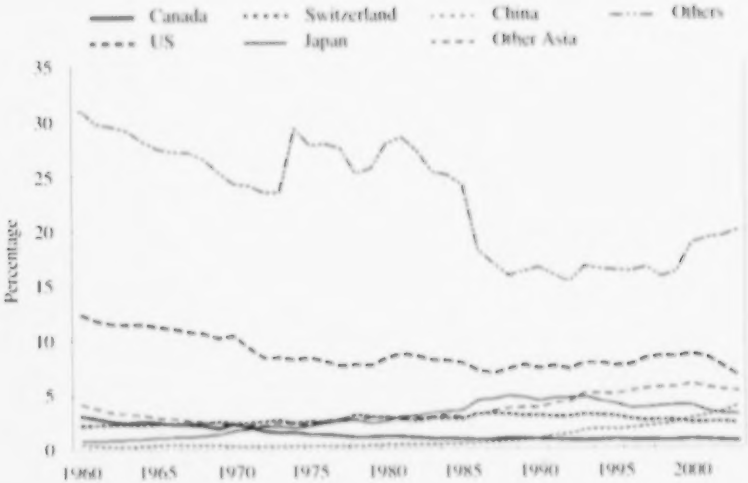
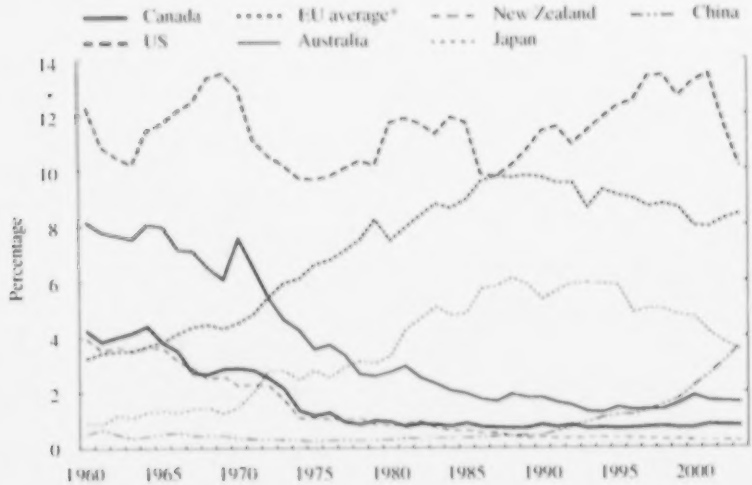


Figure A2.12
UK imports by country
(share of total UK imports)



* Four largest EU trading partners.

Figure A2.13
Canadian imports from the EU by sector
(share of total imports from the EU)

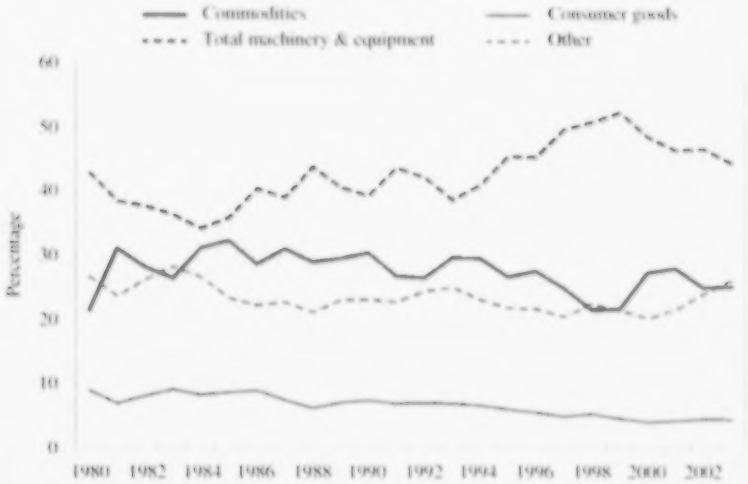


Figure A2.14
Canadian commodity imports from the EU by subsector
(share of total imports from the EU)

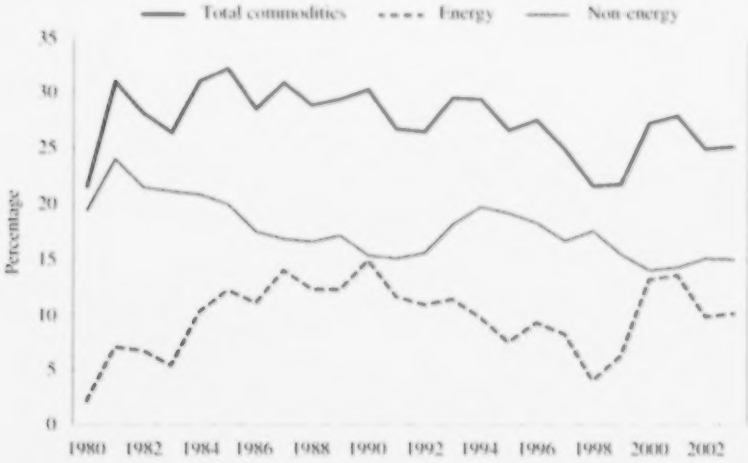


Figure A2.15
Canadian M & E imports from the EU by subsector
(share of total imports from the EU)

Figure A2.16
Canadian imports from the EU by sector
(share of total imports from all countries)

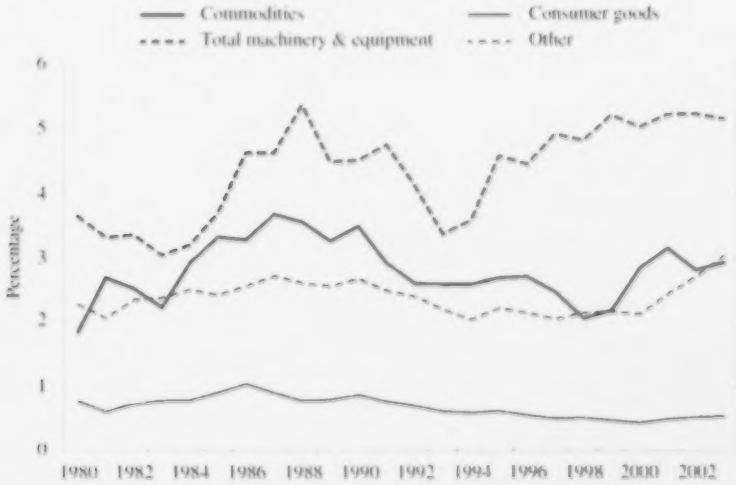


Figure A2.17
Canadian exports to the EU by sector
(share of total exports to the EU)

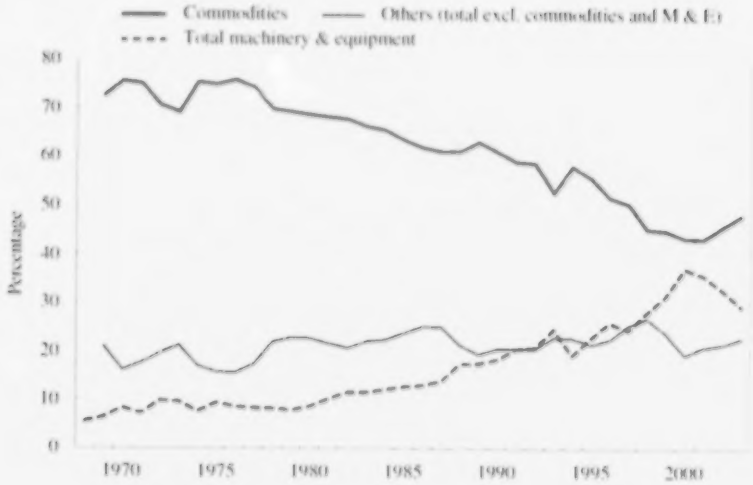


Figure A2.18
Canadian commodity exports to the EU by subsector
(share of total exports to the EU)

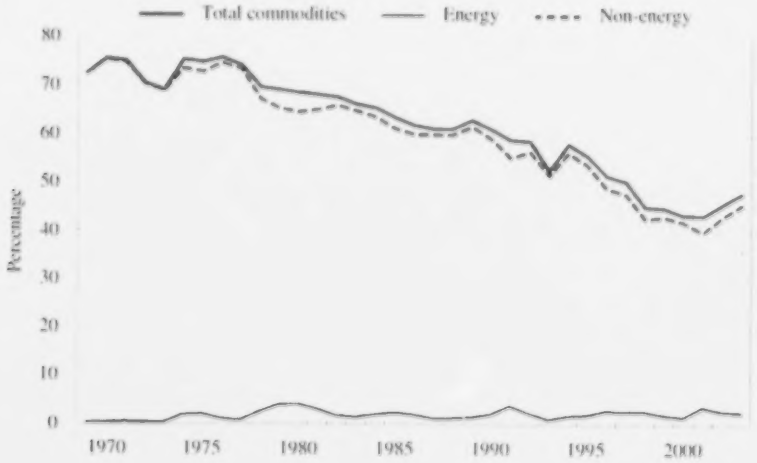


Figure A2.19
Canadian M & E exports to the EU by subsector (share of total exports to the EU)

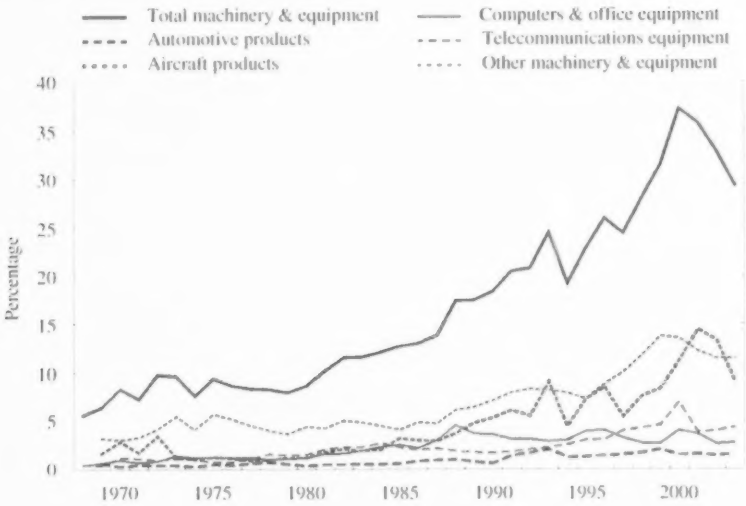


Figure A2.20
Canadian exports to the EU by sector (share of total exports to all countries)

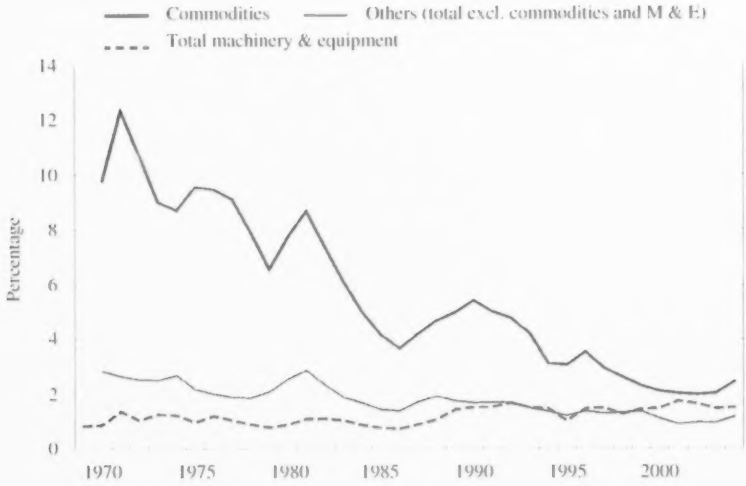


Figure A2.21
Canadian commodity exports to United Kingdom by subsector (share of total exports to all countries)

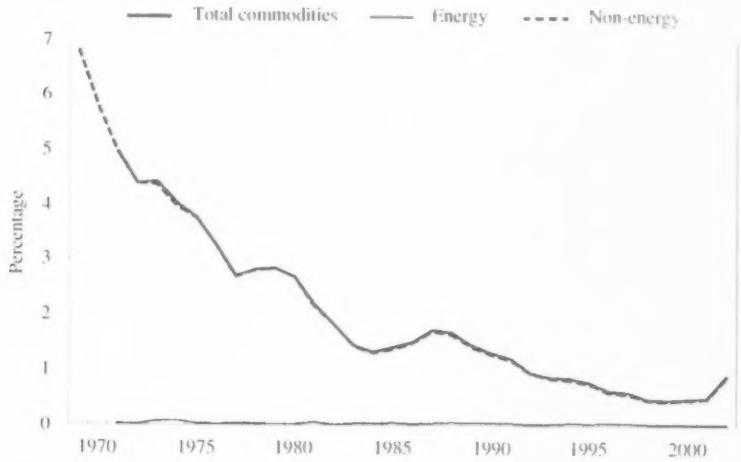


Figure A2.22
Canadian exports to all countries by sector (share of total exports to all countries)

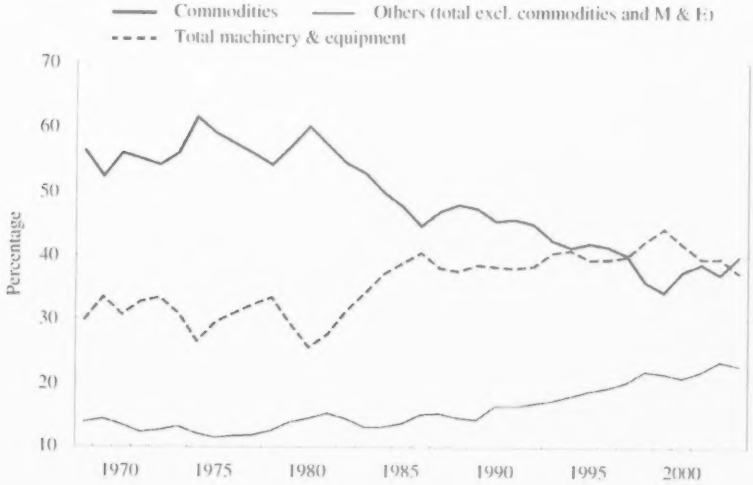


Figure A2.23
Canadian direct investment abroad by country
(share of total Canadian investment abroad)

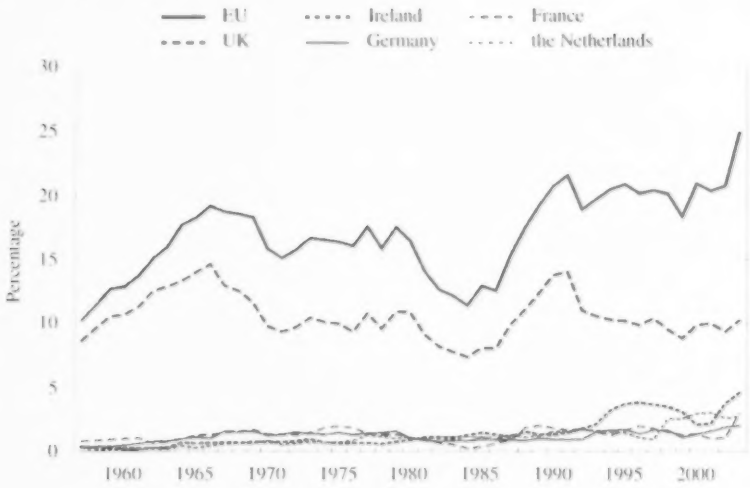


Figure A2.24
Foreign direct investment in Canada by country
(share of total foreign direct investment in Canada)

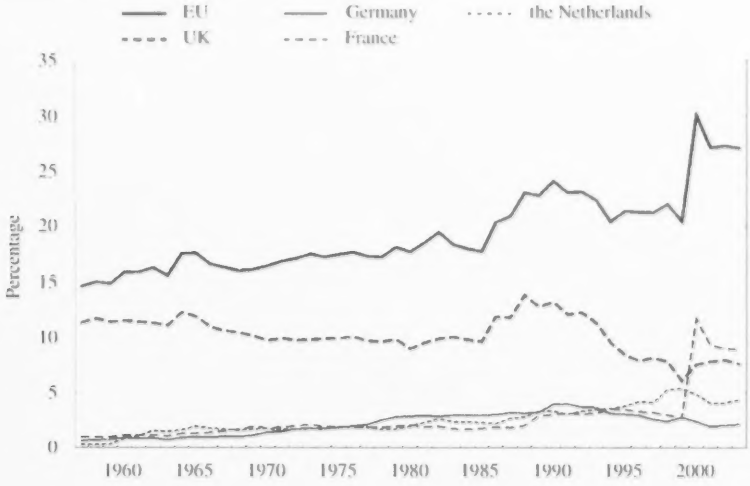


Figure A2.25
Foreign direct investment in Canada by country (share of EU foreign direct investment in Canada)

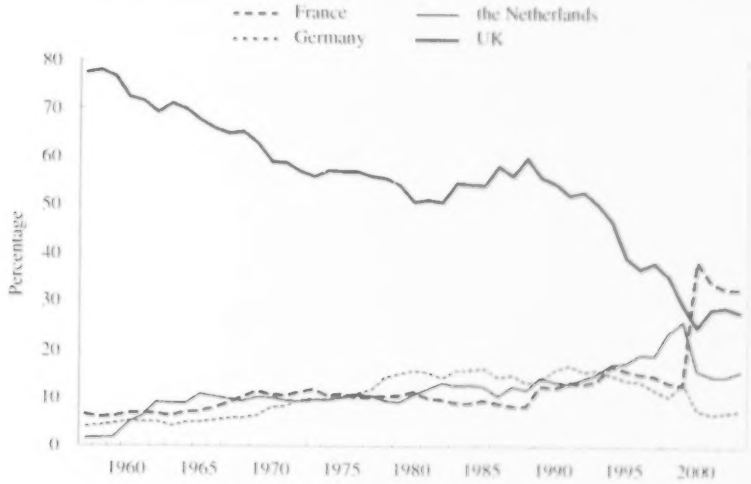


Figure A2.26
Canadian direct investment abroad by country (share of total Canadian investment in the EU)

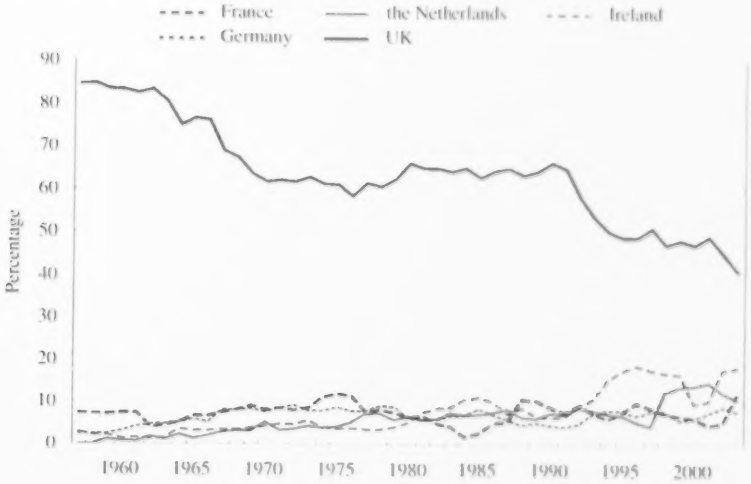


Figure A2.27
Fundamental determinants of Canadian exports to the EU*

* Simple average of individual EU15 countries.
** +(−) appreciation (depreciation) of the Canadian dollar

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Discussion

Marcel Fratzscher

The process of European integration is in many ways a unique experiment. One issue that has been widely studied is whether this process, in addition to the benefits it provides, has negative repercussions for other economies by inducing trade creation within Europe at the expense of trade diversion with other economies. Cameron, Côté, and Graham tackle this issue for the case of Canada by asking whether Canada's exports to the European Union (EU) have declined as a result of EU integration. They do so by presenting a broad array of stylized facts relating to Canada's trade patterns and market shares, and by estimating a simple export share model of Canada vis-à-vis 14 of the old EU countries.

The authors focus on the key stylized fact of Canada's decline of export share in the EU since 1960. They put forward two hypotheses to explain this decrease. First, EU integration may have raised intra-EU trade at the expense of trade diversion with non-EU members. Second, the removal of preferential treatment by the United Kingdom of Canadian exports in the 1960s and 1970s may have contributed to the steady decline of market share of Canadian exports. I would stress that the two hypotheses are separate and distinct. In fact, I will argue that the evidence presented in the paper supports the second hypothesis, and that there is compelling evidence against the first. Moreover, other explanations, foremost among them the integration of Canada with the United States, may play a critical role in the evolution of Canada's exports over the past five decades.

In their investigation of the two hypotheses, the authors present an interesting and compelling picture of Canada-EU trade since the 1960s. The main factor that accounts for the drop of Canada's export share in the EU is the decline of its exports of non-energy commodities to the United Kingdom (Figures A2.6 and A2.17). By contrast, the export share to other EU

countries has remained relatively stable since the 1960s. This already suggests that if there had been trade diversion from EU integration, one would have expected that Canada's export shares in other, non-UK EU countries should have dropped as well. However, we do not observe this. Even stronger evidence against the trade-diversion hypothesis is that intra-EU trade has remained stable at around 60 per cent since the mid-1960s (Figure A2.8). Again, if trade diversion from EU integration had been such a force, one would expect intra-EU trade to rise relative to extra-EU trade. Both pieces of evidence thus rule against the trade-diversion hypothesis, at least for the EU excluding the United Kingdom.

This leads to the questions of why the United Kingdom was, and to some extent still is, such an important partner for Canada, and how to explain the sharp drop in Canada's export shares in the United Kingdom. The authors discuss the special relationship between Canada and the United Kingdom in the 1960s and 1970s and how this has resulted in very close trade and investment ties between the two economies. A remarkable feature is that in the 1960s, Canada had an export market share in the United Kingdom of around 8 per cent, compared to only 12 per cent for the United States and to only 4 per cent each for Germany and France (Figure A2.12). It is in many ways impressive that a smaller and quite distant economy such as that of Canada had about twice the market share of UK neighbouring countries such as France and Germany. From this 8 per cent share in the 1960s, Canada's export market share in the United Kingdom has fallen to around 2 per cent in recent years. But does this decline reflect the effects of EU integration or other factors?

One way of understanding this decline is to investigate the counterfactual: in a world free of trade barriers, preferential treatments, and trade agreements, what would Canada's trade with the EU, and in particular with the United Kingdom, be? Clearly, the counterfactual question is inherently difficult to answer. But it seems obvious that Canada's export market share in the United Kingdom of around 8 per cent in the 1960s, compared to only 4 per cent each for Germany and France, was most likely not a natural outcome that reflected "normal" levels of trade between the two countries, but the result of the above-mentioned preferential treatment of Canada's exports by the United Kingdom.

The literature frequently employs gravity models of trade to find not only the determinants of trade, but to derive such "normal" or equilibrium trade shares that are explained by factors such as distance, common borders, transportation, and communication costs, and not by trade barriers or trade agreements. The authors note that relatively little work has been done on Canada-EU trade, but it seems obvious that an 8 per cent export market

share for Canada, compared to 4 per cent for countries such as France or Germany, was not such an equilibrium level, but rather an artificially high level. By contrast, the 2 per cent export market share Canada now has in the United Kingdom seems much closer to what one would expect to find in a gravity model of trade. Therefore, this finding that Canada's current trade share with the EU is largely in line with what one would expect based on factors independent of EU integration, provides an additional argument against the trade-diversion hypothesis of EU integration.

The second main element of the paper is an empirical model based on Canada's export market shares. In the benchmark model, the size of export market shares has two principal determinants: price competitiveness—proxied by relative real exchange rates—and relative demand—proxied by relative income. The authors estimate this model for a panel of 14 country pairs, *i.e.*, of Canada vis-à-vis 14 of the old EU member states. They find that relative demand is a significant factor in explaining the time and cross-sectional variations in export market shares. The authors then extend the model to include country dummies and time trends. The country dummy for the United Kingdom is positive and significant, indicating that Canada traditionally has higher exports to the United Kingdom than to other EU countries. Moreover, the time trend for the United Kingdom is negative, indicating a decline in Canada's export market share to the United Kingdom over time, even after controlling for price competitiveness and relative demand. By contrast, the time trend for the EU excluding the United Kingdom is not significant in the benchmark model of Table 2.

These findings are interesting, although not easily interpreted. In particular, what do the model's time trends capture? Do they really reflect EU integration? First, the EU integration process has been far from linear and steady since the 1950s. In fact, some work in the literature has shown that European integration has gone through phases of very rapid progress, such as the 1960s and late 1980s-early 1990s, while in other decades there was little change in terms of economic integration (see, e.g., Dorrucci et al. 2004). Other strands in the literature stress that exchange rate uncertainty, and, in particular, the creation of currency unions, such as achieved with the European monetary union in 1999, have a marked impact on trade (Rose and van Wincoop 2001). This suggests that the model's linear time trend may indeed not capture EU integration well.

Second, the stylized facts that the paper presents implicitly propose a potentially important, complementary explanation for the decline of Canada's export shares in the EU. This explanation is that the rapid integration of Canada with the United States may have induced trade diversion away from trade with the EU. In fact, there are several pieces of

strong evidence for this hypothesis. In particular, Canada's exports to the United States, as a share of its total exports, rose from around 55 per cent in the 1960s to 85 per cent in recent years. Canada's export shares to the EU correspondingly declined significantly, but so did Canada's exports—again not in absolute terms but as a share of Canada's total exports—vis-à-vis most of its trading partners apart from the United States. This 85 per cent export share to the United States compares to intra-EU trade of currently only around 60 per cent, and has been stable since the mid-1960s.

Together, these two pieces of evidence suggest that it was not EU integration but Canada-US integration that caused trade diversion, thus possibly explaining an important part of the drop of Canada's export shares in the EU. It would therefore be important to test this hypothesis in the paper's proposed export share model, and also to control for a potential excluded-variable problem of a model that looks only at Canada's trade with the EU. Another interesting test would be to exclude commodities from the empirical model to determine whether the current results are driven by this one sector or whether they hold for all export sectors.

In summary, the authors tackle an interesting issue from both a Canadian and a European perspective. My reading of the evidence in the paper is that EU integration most likely has led to remarkably little, if any, trade diversion away from extra-EU trade. In fact, Canada's current export market shares in the EU seem very much in line with what gravity models of trade would tell us they should be, despite existing preferential trade within the EU. The main factor explaining the decline of Canada's export market shares in the EU is its rapid drop of trade with the United Kingdom, from (possibly unsustainably) high levels in the 1960s. An interesting hypothesis for future research is to extend this work to understand to what extent Canada's integration with the US economy has induced diversion of the trade with the rest of the world and whether it can explain Canada's evolving trade patterns.

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General Discussion*

Michael Francis agreed with Steven Kamin's comments, pointing out that it was quite a challenge to isolate the impact of developments in India and China on Canada. Christopher Graham agreed with Marcel Fratzscher's comments and recognized the need to consider the effect on North American economic integration in his analysis.

In the general discussion that followed, Paul Masson suggested that the Cameron, Côté, and Graham paper would benefit from estimating the effects of tariff reductions and taking into account the fact that these trends occurred when tariffs were being reduced globally under successive GATT/WTO (General Agreement on Tariffs and Trade/World Trade Organization) rounds. Graham responded that tariff data availability was a problem. Masson added that the Desroches, Francis, and Painchaud paper probably exaggerated the effect of institutions. He also noted a number of problems related to data quality in the growth-regression literature. Francis agreed with Masson, but pointed out the difficulty of measuring such things as the shift of China from a command and control economy to a market economy. Richard Harris was surprised by the estimated impact of China's opening to trade on Canada's growth. Francis replied that more work is needed to check the regression results and to explore non-linear relationships. He said that the results are not meant to imply that openness should not be encouraged, only that it is more beneficial when institutional quality is higher. (In effect, there is no welfare analysis in the paper.)

* Prepared by Robert Lafrance.

Andrew Rose, based on his own work with these data, pointed out that the PSI rankings in the Desroches, Francis, and Painchaud paper were often counter-intuitive and not particularly informative. Francis concurred, noting that, for instance, energy-exporting industrial countries (such as Norway) can get a low PSI ranking because of low and medium income oil exporters. Rose added that in the Cameron, Côté, and Graham paper, the data suggested that the United Kingdom was the dominant factor, not tariffs, and that this could reflect the slow growth that the United Kingdom experienced compared to the other EU countries. He also pointed out that trade diversion as envisaged by Jacob Viner implies estimating the net gains or losses for the country as a whole, not trade flows or shares. Denise Côté argued that in future work, the degree of openness would need to be controlled for before estimating the degree of trade diversion.

John Kuszczak Memorial Lecture

Canada's Exchange Rate: New Evidence, a Simple Model, and Policy Implications

*Charles Engel**

Introduction

Canada and the United States are two large economies sharing the North American continent, but separated by an exchange rate. Should monetary policy stabilize the Can$/US$ exchange rate? Or does the movement in the exchange rate reflect optimal adjustment to shocks to the Canadian and US economies?

This paper proceeds to explore the question by:

- Examining the evolution of the "border effect" as measured by goods-price deviations between Canada and the United States. Following the methods of Engel and Rogers (1996) and Engel, Rogers, and Wang (2004), we construct a measure of the degree of integration of the US and Canadian economies. We show how this border measure has evolved since 1990. The apparent barriers actually rise steadily from around 1994 and peak around 2001, before falling dramatically in the past few years.
- Reviewing the evidence on the determination of the Canadian real exchange rate. Amano and van Norden (1995) and Chen and Rogoff

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(2003) estimate models that show that the Canadian dollar strengthens as the price of commodities rises. Both papers present a model that explains this relationship by relating export prices of commodities to changes in the price of non-traded to traded goods.

- Accounting for the movements in the Can$/US$ real exchange rate. We find that movements in the relative price of non-traded goods do not appear to explain much of the real exchange rate movement over the past 15 years. But we do find that the real exchange rate tracks nominal exchange rate movements very closely. This behaviour is consistent with the hypothesis that consumer goods are sticky in local currencies (Canadian dollars in Canada, and US dollars in the United States). This finding can also explain the seemingly anomalous behaviour of the border effect.
- Constructing an alternative model that might account for the behaviour of commodity prices and the Canadian dollar. In this model, the short-run impact of an increase in commodity prices works like a transfer from the United States to Canada. In a simple version of the model of Devereux and Engel (2004), we find that such a transfer leads to a nominal and real appreciation of the Canadian dollar.
- Examining policy implications of such a model. A number of distortions in the economies inhabit this model. There is nominal price stickiness, and there is market incompleteness, so that it is not possible to ensure against fluctuations in commodity prices. We find that optimal co-operative monetary policy smoothes exchange rate fluctuations relative to the exchange rate behaviour that would emerge if monetary policy took a neutral stance.

The evidence and the model presented in this paper are simple. They are certainly not definitive enough that the policy implications should be taken literally. The objective, rather, is to suggest an alternative paradigm for Canada's "commodity currency." The arguments of this paper at best suggest a role for further empirical and theoretical investigation.

1 Border Effects

If two markets for consumer goods are well integrated, prices should not differ greatly across the pair of markets. If formal trade barriers, transportation costs, exclusivity of distribution networks, etc., are low, we might say the markets are well integrated. Engel and Rogers (1996) (referred to as ER hereinafter) assessed the integration of Canadian and American markets for goods by examining prices across a number of cities in the two countries. They found that the markets were, surprisingly, not very well integrated.

They also discovered that the border between the United States and Canada acted as a much larger barrier than physical distance between cities. Pairs of cities that lie across the US-Canada border showed much less harmony in prices than city pairs within each country, even if the within-country pairs were in very distant markets. In other words, there was a large border effect.

Engel, Rogers, and Wang (2004) re-examine the border effect using a new source of data. The data are from the Economist Intelligence Unit (EIU), and they measure the prices of 97 consumer goods in 12 US cities and 4 Canadian cities. The data are annual, from 1990 to 2004. EIU collects the data to compare cost of living for cities throughout the world. The data are for a wide variety of products. Seventy-six of the prices are for goods: 41 food items, 8 clothing items, 6 consumer durables, and 21 other products. Typical items are tomatoes, ground beef, six-year aged Scotch whiskey, women's cardigan sweater, two-slice electric toaster, and Aspirin (100 tablets). The remaining 21 items are services, such as men's haircut (including tip) and one hour's babysitting. Table 1 lists the products that we use in this study.[1]

There are three key differences between these data and those used by ER:

(i) The goods and services in these data are very narrowly defined. ER use fairly broad categories, such as "food at home" and "men's clothing."

(ii) The data are not collected by a government statistical agency. The EIU data are not nearly as well documented as official consumer price data collected in the United States and Canada. One might suspect that the prices in this study are not as representative as those in the official data. Also, the array of goods and services is not as comprehensive as those in the official data.

(iii) These data are actual prices. The official data used by ER are price indexes. Price-level comparisons are not possible with index data. ER attempt to measure price deviations by looking at changes in the price index in one city compared with another. If the prices are equal, then the price changes should also be equal. But there are obvious drawbacks to this approach as a means of determining how large the deviations from price equality are.

The empirical exercises undertaken here are very similar to those in Engel, Rogers, and Wang (2004). The chief difference is that Engel, Rogers, and Wang estimate a constant border effect using panel methods for the entire 1990–2002 data span. Here, we allow the border effect to vary from year to

1. In a typical year, the EIU reports prices on many more products. We use 97 items, because price data for all of them are available for each city for every year. The EIU reports data for various types of outlets in some instances. In all cases, we use the low-price outlet.

Table 1
List of cities and goods

US cities	Boston, Chicago, Cleveland, Detroit, Houston, Los Angeles, Miami, New York, Pittsburgh, San Francisco, Seattle, Washington, DC	
Canadian cities	Calgary, Montréal, Toronto, Vancouver	
Goods (type of retail outlet)		
White bread (1 kg)	Drinking chocolate (500 g)	Women's dress, ready to wear, daytime
Butter (500 g)	Coca-Cola (1 L)	Women's shoes, town
Margarine (500g)	Tonic water (200 ml)	Women's cardigan sweater
White rice (1 kg)	Mineral water (1 L)	Women's tights, panty hose
Spaghetti (1 kg)	Wine, common table (750 ml)	Child's shoes, sportswear
Flour, white (1 kg)	Beer, local brand (1 L)	Hourly rate for domestic cleaning help
Sugar, white (1 kg)	Beer, top-quality (330 ml)	Babysitter's rate per hour
Cheese, imported (500 g)	Scotch whiskey, six years old (700 ml)	Compact disc album
Cornflakes (375 g)	Soap (100 g)	Television, colour (66 cm)
Milk, pasteurized (1 L)	Laundry detergent (3 L)	Kodak colour film (36 exposures)
Olive oil (1 L)	Toilet tissue (two rolls)	Cost of developing 36 colour pictures
Peanut or corn oil (1 L)	Dishwashing liquid (750 ml)	Daily local newspaper
Potatoes (2 kg)	Batteries (two, size D/LR20)	Paperback novel (at bookstore)
Tomatoes (1 kg)	Frying pan (Teflon or good equivalent)	Three-course dinner at top restaurant for four people
Oranges (1 kg)	Electric toaster (for two slices)	Four best seats at cinema
Apples (1 kg)	Laundry (one shirt)	Low-priced car (900–1299 cc)
Lemons (1 kg)	Dry cleaning, man's suit	Family car (1800–2499 cc)
Bananas (1 kg)	Dry cleaning, woman's dress	Deluxe car (2500 cc upwards)
Lettuce (one)	Dry cleaning, trousers	Cost of a tune-up (but no major repairs)
Peas, canned (250 g)	Aspirin (100 tablets)	Hilton-type hotel, single room, one night including breakfast
Peaches, canned (500 g)	Razor blades (five pieces)	Moderate hotel, single room, one night including breakfast
Sliced pineapples, canned (500 g)	Toothpaste with fluoride (120 g)	One drink at bar of first-class hotel
Beef: steak, entrecôte (1 kg)	Facial tissues (box of 100)	Two-course meal for two people

(cont'd)

Table 1
List of cities and goods (cont'd)

Beef: stewing, shoulder (1 kg)	Hand lotion (125 ml)	Simple meal for one person
Beef: roast (1 kg)	Lipstick (deluxe type)	Regular unleaded petrol (1 L)
Beef: ground or minced (1 kg)	Man's haircut (tip included)	Taxi: initial meter charge
Pork: chops (1 kg)	Woman's cut and blow-dry (tip included)	Taxi rate per additional kilometre
Pork: loin (1 kg)	Cigarettes, Marlboro (pack of 20)	Taxi: airport to city centre
Ham: whole (1 kg)	Cigarettes, local brand (pack of 20)	International foreign daily newspaper
Chicken: fresh (1 kg)	Electricity, monthly bill for family of four	International weekly news magazine
Instant coffee (125 g)	Men's business suit, two-piece, med. weight	One good seat at cinema
Ground coffee (500 g)	Men's business shirt, white	
Tea bags (25 bags)	Socks, wool mixture	

year (extending the data to 2004) and trace the evolution of the border barrier.

We measure integration by estimating an equation that explains the absolute value of the log price difference of good i between locations j and k: $|p_{i,j} - p_{i,k}|$, where $p_{i,j}$ refers to the log of the price expressed in US dollars of good i in city j. All prices are expressed in US dollars so that we can compare them across all cities.[2]

Following the literature that estimates the gravity model of trade, we use the log of the distance between locations j and k, $dist_{jk}$ as an explanatory variable. ER present a simple model of how distance might also help explain deviations from the law of one price. While ER discuss a few possible reasons why distance might influence prices, the most plausible focuses on distribution costs. Distribution costs are a large component of the final consumer price,[3] and are more likely to be similar for neighbouring locations. Distribution tends to be labour-intensive, and labour markets may be more tightly integrated if they are nearer geographically.

We also use the absolute value difference in the log of the population between cities j and k, pop_{jk}, as an explanatory variable, because larger cities tend to have higher prices. For the United States, the data refer to Metropolitan (MSA) Population Data. For Canada, the data are described as "Total Population, Census Div/Metro Areas."[4]

A dummy variable, $bord_{jk}$, which takes on the value of one if cities j and k lie on opposite sides of the national border between the United States and Canada, is meant to capture the degree of integration between US and Canadian markets. The coefficient on this variable measures the absolute average log price difference between US and Canadian cities that is not explained by distance or city size (or one of the dummy variables described below).

2. This means that the Canadian-dollar price of goods sold in Canadian cities is converted into US-dollar values by multiplying by the US dollar per Canadian dollar exchange rate. The EIU survey reports prices in US-dollar terms, converted using "the market exchange rate on the date of the survey."

3. Burstein, Neves, and Rebelo (2003) find that distribution costs account for up to 40 per cent of the cost of consumer goods.

4. The US data are from the Census Bureau, and the Canada data from Statistics Canada. The US data were downloaded from: <http://recenter.tamu.edu/Data/popm>, and the Canadian data from Haver in the CANSIMR database (Canadian regional economic indicators).

We also include a dummy variable for each city, $citdum_j$, that takes on the value of one if one of the cities in the city pair is city j. This variable captures idiosyncratic aspects of the price of a given city.

We estimate this regression for each of the 15 years in our sample:

$$|p_{i,j} - p_{i,k}| = \beta_1 dist_{jk} + \beta_2 pop_{jk} + \beta_3 bord_{jk} + \sum_{h=1}^{N} \alpha_h citdum_h + u_{i,jk}. \quad (1)$$

This equation was estimated for all the goods and services together and then separately for the goods and the services.

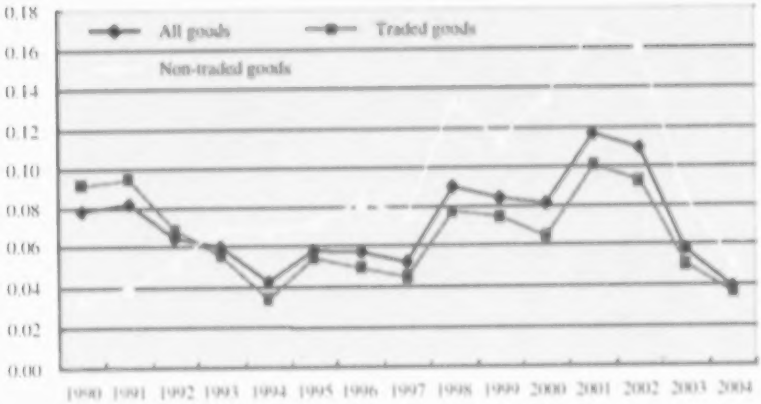
In contrast to the findings of Engel, Rogers, and Wang (2004), the estimated coefficients on the distance variable are rarely statistically different from zero. The distance coefficient takes on the correct sign in 14 of the 15 years, but is statistically significant (in a one-sided test at the 5 per cent level) in only 4 of the years. The population variable fares better. It takes on the expected sign in 14 of the 15 years, and was statistically significant (again in a one-sided test at the 5 per cent level) in 9 of the years. Compared with Engel et al. (2004), the lack of statistical significance in these regressions is probably attributable to the lower power of the tests when the regressions are run year by year as opposed to as a panel regression.

But we do find that the border coefficient is of the right sign and easily statistically significant (at the 5 per cent level) in all years. Figure 1 plots the estimated border coefficients. In the graph, we refer to goods as "traded goods" and to services as "non-traded goods" on the grounds that the physical goods in our sample are easily transportable across borders, while the services are not. The numbers on the vertical axis can be interpreted as the average log price deviation imposed by the border effect.

For all goods and services, and for the subset of traded goods, the border coefficient falls initially in the early 1990s from around 0.08 (or, roughly 8 percentage points) to 0.04 for traded goods (and slightly higher for all goods). But then, in the period from 1994 to 2001, the border coefficient for traded goods rises back to around 0.10. Finally, between 2001 and 2004, the coefficient falls back to about its 1994 level of 0.04. The border effect for non-traded goods shows a nearly monotonic increase from 1990 to 2001, rising from around 0.03 to 0.17. But then between 2001 and 2004, it falls sharply to approximately 0.05.

What accounts for these fluctuations in the border effect? Did the US and Canadian economies really become less integrated during much of the

Figure 1
Estimated "border coefficients" (1990–2004)



1990s? And why has there been a sudden apparent increase in integration since 2001? We return to these questions in section 3.

2 The Canadian Dollar and the Commodity Terms of Trade

Here, we review empirical evidence gathered by Amano and van Norden (1995) and Chen and Rogoff (2003) that links the value of the Canadian dollar to the export price of non-energy commodities. Both papers find evidence that as the price of commodities increases, the value of the Canadian dollar strengthens (in real terms).

The studies take slightly different approaches, but reach essentially the same conclusion. Amano and van Norden (1995) use monthly data on commodity prices from 1973Q1 to 1992Q2 to estimate an error-correction model that relates Canada's real CPI exchange rate relative to the United States to commodity prices and oil prices. In this dynamic model, they find that an increase in commodity prices leads to a real appreciation (while, surprisingly, the effect of oil prices on the real Canadian dollar is in the opposite direction).

Chen and Rogoff (2003) revisit this relationship, using quarterly data from 1980QI to 2000QI. They find a statistically significant relationship between the Can$/US$ real exchange rate and the non-energy commodity price index

for some (but not all) of their statistical specifications.[5] They note that the relationship between the commodity terms of trade and the real exchange rate seems to be tighter for Canada relative to its large, non-US, trading partners.

What explains the relationship of the commodity terms of trade with the real exchange rate? Both papers offer similar explanations. It is helpful to quote directly from Chen and Rogoff (2003, 149):

> First, consider the following extension of the flexible-price Balassa-Samuelson model. Let Home be a small economy whose agents consume three goods—non-traded goods, exports, and imports—but produce only the first two. Assume that labour is perfectly mobile across industries, and that physical capital can be freely imported from abroad at real interest rate r, measured in importables. The production function for exportables is $y_X = A_X f(k_X)$, where y and k are output and capital per unit labour, respectively, and $y_N = A_N f(k_N)$ is the analogous function for non-traded goods production. Let p_X be the world price of exportables, which is given exogenously to the small country, and p_N be the Home price of non-traded goods, both measured in terms of importables. Then, assuming that labour mobility leads to a common wage across the two Home industries, one can derive the approximate relation:
>
> $$\hat{p}_N = \left(\frac{\mu_{LN}}{\mu_{LX}}\right)(\hat{A}_X + \hat{p}_X) - \hat{A}_N$$
>
> where a "hat" above a variable represents a logarithmic derivative, and μ_{LN} and μ_{LX} are labour's income share in the non-traded and export goods sectors, respectively. Thus, the effect of a rise in the relative price of exportables is the same as a rise in traded goods productivity in the standard Balassa-Samuelson model. The impact on the real exchange rate depends, of course, on the utility function. Assume a simple logarithmic (unit-elastic) utility function: $U = C_N^{\alpha} C_I^{\beta} C_X^{(1-\alpha-\beta)}$. Normalizing the price of importables to one, the consumption-based consumer price index is then given by $p_N^{\alpha} p_X^{(1-\alpha-\beta)}$. Therefore, as $\hat{p}_N$ moves proportionately in response to $\hat{p}_X$,

5. They also examine the statistical relationship for other "commodity currencies"—of Australia and New Zealand. For these countries, they find that the link between commodity prices and exchange rates is more robust to statistical specification than for Canada.

the effect of an export price shock on the utility-based real CPI is then given by $\hat{p}_X^{(1-\beta)}$. Assuming that importables account for 25% of consumption, the elasticity of the CPI with respect to a unit change in the price of exportables would be 0.75, which is broadly consistent with our estimated coefficients. (If $\mu_{LN} > \mu_{LX}$—it is standard to assume that non-traded goods production is more labour intensive—one would get a larger effect.)

Here, we do not challenge the empirical work linking the value of the real Canadian dollar to commodity prices, but we offer evidence that the mechanism linking the two does not work through the relative price of non-traded goods. We argue that the evidence on Canadian prices and the exchange rate is consistent with a view that the Canadian CPI, expressed in units of Canadian dollars and denoted P, and the US CPI, expressed in US dollars and denoted P^*, are sticky in their local currencies. That is, Canadian consumer prices are set in Canadian dollars and adjust sluggishly, and US consumer prices are set in US dollars and also adjust slowly. The implication is that the real Canadian exchange rate, given by SP^*/P, where S is the Canadian dollar per US dollar exchange rate, is tightly linked to the nominal exchange rate S. Call this model the LCP (local currency pricing) model.

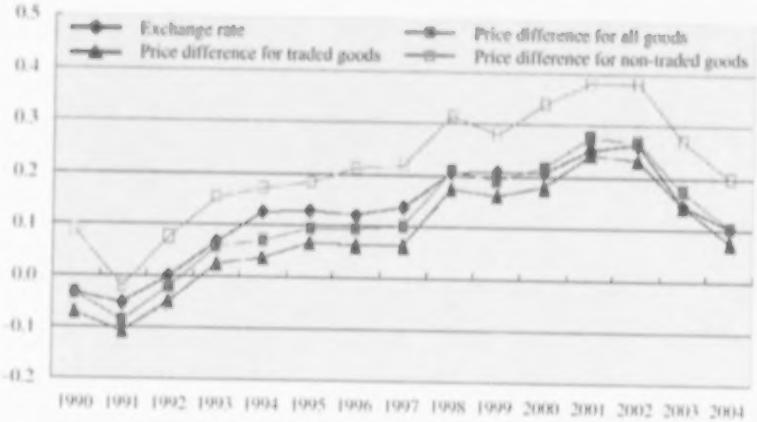
Section 3 presents evidence supporting this view and evidence against the model in which the Canadian real exchange rate is driven by the relative price of non-traded goods. Section 4 presents an alternative model of how an increase in commodity prices might lead to a real appreciation that is consistent with the data.

3 Evidence on Canada's Real Exchange Rate

Figure 2 plots a measure of Canada's real exchange rate based on the price data from the EIU, annually from 1990 to 2004. The line is denoted "price difference for all goods." This line is calculated by taking $p_{i,USk} - p_{i,CAj}$, the log of the price of good i in US city k relative to log of the price of good i in Canadian city j, with both expressed in a common currency. We first average this price difference for each good i across all Canadian/US city pairs and across all goods.

An increase in this price indicates that US consumer prices are rising relative to Canadian consumer prices. That is, an increase reflects a real depreciation of the Canadian dollar. Figure 2 shows that sometime between 1992 and 1993, average prices became higher in the United States than in Canada (the average price difference exceeds zero). That price differential

Figure 2
Relative prices and exchange rates for Canada and the United States



rose until it peaked in 2001 at nearly a 30 per cent difference. Between 2001 and 2004, the average price differential fell to around 10 per cent.

Figure 2 also plots s, the log of S, the Canadian dollar per US dollar exchange rate. For graphical purposes, the 1990 value of s was set equal to the 1990 value of the relative price. The plot indicates remarkably close movement between the real and nominal exchange rates. In log levels, the correlation coefficient is 0.979, and in first differences it is 0.882.

That evidence alone strongly supports the view that Canadian consumer prices are set in Canadian dollars, and US consumer prices are set in US dollars. But it is not definitive. In fact, the close correlation of real and nominal exchange rates is perfectly consistent with a world in which there is complete nominal price flexibility and where real exchange rates are linked to the relative price of non-traded goods.

To see this, following Chen and Rogoff's exposition of the classical model, let the nominal price index in Canada be given by $P_N^{\alpha} P_T^{1-\alpha}$, where P_N is the nominal price of non-traded goods, and P_T is the nominal price of traded goods. Following the model of Chen and Rogoff, P_T is an index of imported and exported traded goods:

$$P_T = P_I^{\frac{\beta}{1-\alpha}} P_X^{\frac{1-\alpha-\beta}{1-\alpha}},$$

where again the upper-case Ps refer to nominal prices.

Assume that foreign consumers have a price index with identical weights. Use lower-case letters to represent prices. (To avoid confusion, I specify here that this notation is at odds with the notation of Chen and Rogoff above. In their model, lower-case *p*s represented the level of prices of goods relative to the numeraire good. Here, lower-case *p*s are the logs of the nominal prices.)

We can write the log of the real exchange rate as:

$$q = s + p^* - p = \alpha(s + p_T^* - p_T) + (1 - \alpha)(s + p_N^* - p_N). \qquad (2)$$

If we now use the usual assumption of the classical model (implicit in Chen and Rogoff's description) that the law of one price holds up to a constant, so that $s + p_T^* - p_T = k$, where k is some constant, we obtain:

$$q = s + p^* - p = \alpha k + (1 - \alpha)(s + p_N^* - p_N), \qquad (3)$$

or

$$q = s + p^* - p = k - (1 - \alpha)[p_N - p_N^* - (p_T - p_T^*)]. \qquad (4)$$

Equation (3) shows us directly that the real exchange rate should be related to the relative price of non-traded to traded goods in the home relative to the foreign country (Canada relative to the United States).

Equation (3) is expressed all in terms of real prices. The classical model can be consistent with a wide variety of behaviour of nominal prices. For example, if Canadian and US policy-makers kept inflation (in local currencies) equal in the two countries, then $p^* - p$ would be constant. In that case, from equation (3), the log of the nominal exchange rate, s, would equal the log of the real exchange rate, q, up to an additive constant. So, the fact that nominal and real exchange rates co-move can be consistent with the classical model in which real exchange rates reflect movements in the relative prices of non-traded goods.

But there are two other implications of the classical model that are directly contradicted by the data. The first is that $s + p_T^* - p_T = k$, i.e., the assumption that the law of one price holds for traded goods (up to a constant). Figure 2 also plots the "price difference for traded goods." It is calculated the same way as the "price difference for all goods," but averages only across prices of traded goods. That is, it is a measure of $s + p_T^* - p_T$.

It is easy to see from Figure 2 that $s + p_T^* - p_T$ is not constant. In fact, it tracks $q = s + p^* - p$ very closely. The correlation of these two series in levels is 0.999. In first differences, the correlation is 0.992. As one might

expect, given these correlations, we also find that $s + p_T^* - p_T$ is highly correlated with the nominal exchange rate, s. The correlation in levels is 0.978, and in differences is 0.883.

This behaviour is completely consistent with a sticky-price LCP model in which the Canadian price of traded consumer goods, p_T, is rigid and preset in Canadian dollars, while the US price of consumer goods, p_T^*, is set in US dollars and adjusts sluggishly.

Figure 2 also graphs the "price difference for non-traded goods," a measure of $s + p_N^* - p_N$ constructed analogously to the measures of $s + p_T^* - p_T$ and $q = s + p^* - p$. From the graphs, it is easy to see that $s + p_N^* - p_N$ is also highly correlated with s, $s + p^* - p$, and $s + p_T^* - p_T$. In levels, those correlations are 0.970, 0.993, and 0.987, respectively. In differences, the respective correlations are 0.816, 0.947, and 0.901.

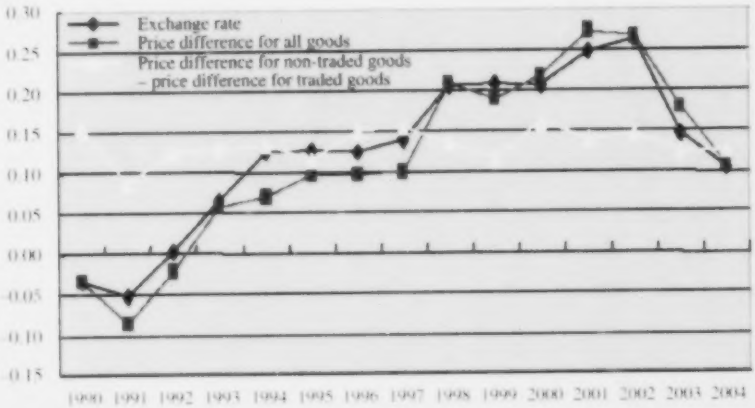
That behaviour is again consistent with local-currency price stickiness of p_N and p_N^*. If all consumer prices are sticky in consumers' currencies, then $s + p_N^* - p_N$, $s + p_T^* - p_T$, and $s + p^* - p$ will all follow s quite closely, as indeed they do in Figure 2.

Note, however, that the close correlation of $s + p_N^* - p_N$ with s or with $s + p^* - p$ is also consistent with the classical model, as equation (2) makes apparent. What the classical model cannot account for are the movements of $s + p_T^* - p_T$: its correlation with s, $s + p^* - p$, and $s + p_N^* - p_N$. But the LCP model is consistent with all of the prices plotted in Figure 2.

The second major implication of the classical model that is inconsistent with the data can be seen in Figure 3. This figure shows "price difference for non-traded goods – price difference for traded goods." This is a measure of $p_N - p_N^* - (p_T - p_T^*)$. Equation (3) of the classical model says that this relative price should be perfectly correlated with the real exchange rate, $q = s + p^* - p$. There is support for the classical model, but the correlations are quite low: 0.340 in levels and 0.218 in differences. In fact, as is evident from Figure 3, $p_N - p_N^* - (p_T - p_T^*)$ is negatively serially correlated at the annual frequency, while $s + p^* - p$ is positively serially correlated and quite persistent.

Equation (3) not only implies that $p_N - p_N^* - (p_T - p_T^*)$ is perfectly correlated with q, but it also implies that $p_N - p_N^* - (p_T - p_T^*)$ is much more volatile than q. The variance of q should be only $(1 - \alpha)^2$ times the variance of $p_N - p_N^* - (p_T - p_T^*)$, where $1 - \alpha$ is the weight of non-traded goods in the price index. Clearly, the relative variances go the other way. (The standard deviation of $p_N - p_N^* - (p_T - p_T^*)$ is only about one-fifth the standard deviation of q!)

Figure 3
Relative prices and exchange rates for Canada-US



On the other hand, the low correlation of $p_N - p_N^* - (p_T - p_T^*)$ with $q = s + p^* - p$ is exactly the prediction of the LCP model, as is the low volatility of $p_N - p_N^* - (p_T - p_T^*)$ compared to q.

If we adopt the LCP model, we are now also able to understand the border puzzle raised in section 1 of this paper. Why did the measured border effect rise throughout most of the 1990s, but then drop from 2001 to 2004? The answer is not in changing trade barriers. The answer is in local currency pricing. While some sort of barriers are needed to explain why consumers do not arbitrage price differences across locations, it is not time variation in those barriers that accounts for time variation in the border coefficient (as seen in Figure 1). Instead, the movements of the border coefficient seem to be mostly related to movements in the exchange rate. As Figure 2 shows, consumer prices in the United States rose relative to those in Canada as the nominal exchange rate rose. It was not until the US dollar began to depreciate that the price gap narrowed and the border coefficients fell. That is, by consumer price measures, the US dollar was overvalued and became increasingly overvalued relative to the Canadian dollar through the 1990s. Since 2001, the US dollar has depreciated and become less overvalued.

Many recent papers[6] have argued that the failures of the law of one price—the deviations of $s + p_T^* - p_T$ from zero—can be explained by distribution

6. Among them prominently are Burstein, Neves, and Rebelo (2003) and Burstein, Eichenbaum, and Rebelo (2004).

costs of traded consumer goods. The argument revives the classical model by explaining that the measured (log) of the price of traded goods, p_T, is actually a weighted average of the true price of traded goods as measured at the dock, p_D, and the price of non-traded goods and services used to bring the traded goods to the consumer:

$$p_T = \psi p_D + (1 - \psi) p_N. \tag{5}$$

We can then substitute this expression (and its counterpart for the foreign country) into $s + p_T^* - p_T$, and amend equation (1) to write:

$$q = \alpha\psi(s + p_D^* - p_D) + (1 - \alpha\psi)(s + p_N^* - p_N).$$

Now, according to this "revised classical" (RC) model, the law of one price holds for traded goods at the dock, so $s + p_D^* - p_D = k$, where k is some constant. So we have

$$q = \alpha\psi k + (1 - \alpha\psi)(s + p_N^* - p_N). \tag{6}$$

At first blush, the RC model seems compatible with our data. On the one hand, we are unable to measure $s + p_D^* - p_D$, because we have only data on consumer prices and not data on true traded goods prices at the dock. So we cannot verify or disprove the assumption that the law of one price holds, $s + p_D^* - p_D = k$.

By analogy to the derivations above, we might rewrite equation (4), under the assumption that $s + p_D^* - p_D = k$, to obtain:

$$q = s + p^* - p = k - (1 - \alpha\psi)[p_N - p_N^* - (p_D - p_D^*)]. \tag{7}$$

But this also does not give us an equation we can verify or refute, again because we do not observe $p_D - p_D^*$.

It would seem that the only equation of the RC model we can examine empirically is equation (5), which implies that $s + p_N^* - p_N$ is highly correlated with $s + p^* - p$. But we have already noted that correlation is high. To be sure, that high correlation is also consistent with the LCP model, and also with the original version of the classical model (see equation (2)) that was refuted by other evidence.

But there is evidence that we can use. Even though p_T is not a perfect measure of the price of traded goods at the dock, p_D, it does contain information about traded prices at the dock. We can exploit the fact that consumer traded goods are intensive in the actual traded good compared with consumer non-traded goods. That is, the share of the true traded goods,

γ, in the price of consumer traded goods is greater than the share of true traded goods in consumer non-traded goods, which is zero.

So, equation (4) can be written as:

$$p_N - p_D = \frac{p_N - p_T}{\psi}.$$

Substituting into equation (6), the RC model implies:

$$q = s + p^* - p = k - \left(\frac{1 - \alpha\psi}{\psi}\right)|p_T - p_T^*|. \tag{8}$$

Equation (7) gives us a relationship between the real exchange rate and sub-indexes of prices we can observe. It is exactly like equation (3) in implying that $p_N - p_N^* - (p_T - p_T^*)$ should be perfectly correlated with the real exchange rate, $q = s + p^* - p$. But this was the empirical implication that Figure 2 refutes.

Equation (3) also had the implication that the variance of $p_N - p_N^* - (p_T - p_T^*)$ had to be greater than the variance of $q = s + p^* - p$. That is not true of equation (7). $p_N - p_N^* - (p_T - p_T^*)$ can have a smaller variance if $1 - \psi > \alpha\psi$. What is the meaning of this condition? $1 - \psi$ is the weight of p_N, the non-traded distribution services, in the price of the traded consumer good, p_T. $\alpha\psi$ is the weight of the price of traded consumer goods at the dock, p_D, in the overall consumer price index, p. That condition could plausibly be met, but recall that in our data the standard deviation of $p_N - p_N^* - (p_T - p_T^*)$ is only one fifth the standard deviation of $s + p^* - p$. For the RC model to account for this, we would need

$$\psi = \frac{1}{\alpha + 5}.$$

For this to be possible, the weight of p_D in p_T would have to be less than one fifth.

Put another way, equation (4) implies that the standard deviation of $s + p_T^* - p_T$ must equal $1 - \psi$ times the standard deviation in $s + p_N^* - p_N$, if the classical model is correct and $s + p_D^* - p_D$ equals zero.[7] In our data, $s.d.(s + p_T^* - p_T) = 0.107$ and $s.d.(s + p_N^* - p_N) = 0.115$. For these statistics to be consistent with the classical model, we would need

7. I thank Mick Devereux for pointing this out to me.

$\psi = 0.073$. That is, the actual traded content of traded goods would have to be very small—only 7 per cent of the total value of the traded consumer good.

So the evidence works against even the RC model of the real exchange rate. A simpler explanation of these data is the LCP model. But what replaces the classical model to explain the relationship between the price of commodities and the real exchange rate? Section 4 sketches a very simple LCP model, based on the work of Devereux and Engel (2004). It incorporates local-currency price stickiness for consumer goods, but potentially can explain the behaviour of commodity currencies.

4 A Simple Model

Here, we outline a very simple model based on Devereux and Engel (2004). (This work is referred to as DE hereinafter.) The model cannot masquerade as a realistic description of the Canadian economy. It is not dynamic and does not allow for any asset trade. It is a two-country model, and so it does not account for the determination of commodity prices in a world economy in which Canada and the United States are a part. Because the model is static, it is not amenable to examining the role of price adjustment. The model does not even account for the different sizes of the US and Canadian economies. But the model may contain the seed of the economics that links commodity prices to the real exchange rate in Canada.

Commodity prices are determined in the global economy, and not just by the supplies and demands of the US and Canadian economies. Our approach assumes that the United States and Canada are small in the markets for commodities—that they are price-takers.

We are concerned about the short-run effects of commodity price changes on exchange rates. The "short run" is the period during which certain nominal prices have not fully adjusted. The model presented here is one in which prices of consumer goods are sticky and set in the currency of the consumer. That is, it is an LCP model, and is thus consistent with the data reported in section 3.

The model treats all consumer goods as non-traded. Final consumer goods are assembled from traded intermediate goods. Consumer goods in each country require locally produced tradable intermediate goods and imported intermediate goods. We assume that the law of one price holds for the traded intermediate goods. We assume that intermediate goods prices are flexible and can adjust to shocks.

Commodities are separate sectors of the economies, and are modelled very simply. In the short run, supply and demand for commodities are highly inelastic. When the price of a commodity increases, in the short run the economic effect is principally an increase in wealth for the exporter and a decrease in wealth for an importer. This leads us to capture the role of commodity price fluctuations in the short run as a simple transfer. When commodity prices rise, there is a transfer from the United States to Canada. That is, there is a decrease in wealth for the importer of commodities (the United States) and an increase in wealth for the exporter (Canada). Given the confines of a two-country model, we are forced to assume that Canada's gain is exactly equal to the US loss.

Our model is essentially the same as that of DE, except for the following differences:

- DE focus on the effects of real shocks to labour supply. In our model, the only source of shocks is to commodity prices, i.e., to the transfer.
- DE mainly examine models in which asset markets are complete. We will assume, to the contrary, that there is no asset trade. Given that the transfer is the only source of shocks, what we mean is that there is no insurance market for these transfers. That is the only missing asset market. If it were in place, asset markets would be complete.
- DE allow some prices to be flexible and some to be fixed, both for consumer prices and for intermediate prices. In DE, some consumer prices are fixed in consumers' currencies and some are flexible. Some intermediate goods prices are fixed in producers' currencies, and some are flexible. Here, we look only at the version of the model in which all consumer prices are set in local currencies and all intermediate prices are flexible.
- We slightly simplify household preferences, having leisure enter the utility function quasi-linearly.
- In assessing monetary policy rules, we do not consider how a change in the rule would affect the ex ante preset nominal prices, as DE do. This consideration might be important if we were considering the welfare implications of various policies, but is not very important in considering the implications of policies for exchange rate smoothing.

Otherwise, the model is identical to that of DE, and their paper contains a fuller exposition of the model than the brief outline contained here.

Household i in the home country has preferences given by:

$$U(i) = \frac{1}{1-\rho} C(i)^{1-\rho} - L(i), \text{ with } \rho > 0. \tag{9}$$

C represents aggregate consumption. It is a constant-elasticity-of-substitution aggregate over a continuum of home-produced final commodities with an elasticity of substitution of $\theta > 1$. L represents labour services that each household uses to produce an intermediate good. Foreign households have identical preferences, but theirs are defined over consumption of final goods sold in the foreign country and foreign labour.

Each household in the home country produces an intermediate good according to the production function $Y_H(i) = L(i)$. Each variety of the final consumption good in the home country is produced using domestic and foreign intermediate good aggregates. For instance, the final good variety j is produced using the home and foreign intermediate good aggregates, respectively $Y_H(j)$ and $Y_F(j)$, with the production function:

$$Y(j) = \left(\left(\frac{1}{2}\right)^{\frac{1}{\gamma}} Y_H(j)^{\gamma-1/\gamma} + \left(\frac{1}{2}\right)^{\frac{1}{\gamma}} Y_F(j)^{\gamma-1/\gamma} \right)^{\gamma/\gamma-1}, \tag{10}$$

where γ is the elasticity of substitution between the home and foreign intermediate goods aggregates. The home intermediate aggregate $Y_H(j)$ is defined over a continuum of home-produced intermediate goods, with elasticity of substitution ϕ:

$$Y_H(j) = \left[\int_0^1 Y_H(i, j)^{\frac{\phi-1}{\phi}} di \right]^{\frac{\phi}{\phi-1}}, \text{ with } \phi > 1,$$

and $Y_F(j)$ is defined analogously. Home households consume all of each home final good variety $Y(j)$.

As noted above, we assume that all consumer prices are set in the consumer currency. Producers of final goods will alter production levels to meet demand. We set the price of consumer goods in each country equal to one.

We eliminate any sources of inefficiency that are due to monopoly pricing wedges in the intermediate goods sectors. To avoid these, we assume that firms receive a per-unit subsidy on production to ensure that price would equal marginal cost. The subsidy is financed by lump-sum profit taxes on the producers.

For household/intermediate-goods producers, the first-order condition for the trade-off between consumption and leisure is:

$$P_H = C^p. \tag{11}$$

This extremely simple equation requires some explanation. Each household i sells its intermediate good at the price $P_H(i)$ (denominated in the home currency). Given that all households are identical, $P_H(i)$ is the same across all households and equal to the aggregate price of home-produced intermediate goods, P_H, in equilibrium. Since we assume that the nominal price of consumer goods is set equal to one, P_H also equals the price of intermediate goods relative to consumption goods. Households set the marginal rate of substitution between consumption and leisure equal to this relative price. Given that the marginal disutility of work equals unity, the marginal rate of substitution equals C^{ρ}, and so we have equation (10).

The decisions of foreign households are analogous to those of home households, so we have their first-order condition given by:

$$P_F^* = C^{*\rho}. \tag{12}$$

Here, P_F^* is the foreign-currency price of foreign-produced intermediate goods.

Demand for labour is a derived demand coming from producers of final goods in each country. Their demand for intermediate goods from each country depends on the level of consumption of the final good in each country, and the relative price of foreign to home intermediate producers, SP_F^*/P_H. We can derive the demand for home labour as:

$$L = \frac{1}{2}P_H^{-\gamma}\left(\frac{1}{2}P_H^{1-\gamma} + \frac{1}{2}(SP_F^*)^{1-\gamma}\right)^{\frac{\gamma}{1-\gamma}}(C + C^*). \tag{13}$$

Note that the demand for home labour coming from foreign final-goods producers (and hence the demand for exports of home intermediate producers) is given by:

$$\frac{1}{2}P_H^{-\gamma}\left(\frac{1}{2}P_H^{1-\gamma} + \frac{1}{2}(SP_F^*)^{1-\gamma}\right)^{\frac{\gamma}{1-\gamma}}C^*.$$

We can also derive demand for foreign labour:

$$L^* = \frac{1}{2}(SP_F^*)^{-\gamma}\left(\frac{1}{2}P_H^{1-\gamma} + \frac{1}{2}(SP_F^*)^{1-\gamma}\right)^{\frac{\gamma}{1-\gamma}}(C + C^*). \tag{14}$$

The balance-of-payments equilibrium condition is that the sum of transfers from the foreign country to the home country plus exports of the home country equals imports of the home country:

$$\tau + \frac{1}{2}P_H^{1-\gamma}\left(\frac{1}{2}P_H^{1-\gamma} + \frac{1}{2}(SP_F^*)^{1-\gamma}\right)^{\frac{\gamma}{1-\gamma}}C^*$$

$$= \frac{1}{2}(SP_F^*)^{1-\gamma}\left(\frac{1}{2}P_H^{1-\gamma} + \frac{1}{2}(SP_F^*)^{1-\gamma}\right)^{\frac{\gamma}{1-\gamma}}C. \tag{15}$$

τ is a monetary transfer, denominated here in the home-country currency. It is assumed to be a random variable. The units of equation (14) are home currency.

Finally, we follow DE in assuming that the instrument of monetary policy makers in each country is nominal consumption. This could be thought of as the equivalent in the static context as control over nominal interest rates. That is, the gross nominal interest rate is equal to the expected marginal utility of a unit of currency today relative to the marginal utility of a unit of currency next period. In the static model, we take expected future values as given. And given that all consumer prices are assumed to be fixed and equal to one in our simple model, the marginal utility of a dollar today is determined by the level of consumption today. So we are assuming that C and C^* are instruments of monetary policy makers.

When monetary policy is passive, so that C and C^* are not responsive to τ shocks, from equations (10), (11), and (14), the effect of a change in the transfer on exchange rates is immediately apparent. Equations (10) and (11) indicate that with no change in C and C^*, P_H and P_F will not change with movements in τ. Therefore, equation (14) tells us how movements in τ affect the exchange rate.

When the home country receives a transfer (τ is positive), it is able to increase the (domestic currency) value of its imports. For a small increase in τ, starting from τ equal to zero, there will be a drop in S—an appreciation of the home currency—when the elasticity of demand for intermediate goods is greater than one. Specifically, we have

$$\left.\frac{ds}{d\tau}\right|_{\tau=0} = \frac{2}{1-\gamma}P_F^{*1-\gamma}S^{-\gamma}\left(\frac{1}{2}P_H^{1-\gamma} + \frac{1}{2}(SP_F^*)^{1-\gamma}\right)^{\frac{\gamma}{1-\gamma}}C^{-1}.$$

This derivative is less than zero when γ is greater than one.

In short, a positive commodity price shock works like a wealth transfer to the commodity exporter. Ultimately, it will increase the value of its imports. When the elasticity of demand for imports is sufficiently high, this requires an appreciation of the currency.

5 Policy Implications

What role might policy play in this setting? There are two sources of inefficiencies in this model. The first is that there is no market to hedge the risk of commodity price changes. Suppose that there was a perfect insurance market for these shocks. This would mean that no transfers take place. Equation (14) would be altered because τ would drop out. In that case, there would be no shocks to the system. Even though nominal consumer prices are sticky, that would have no meaning, because there would be no shocks that would cause optimal prices to deviate from preset levels.

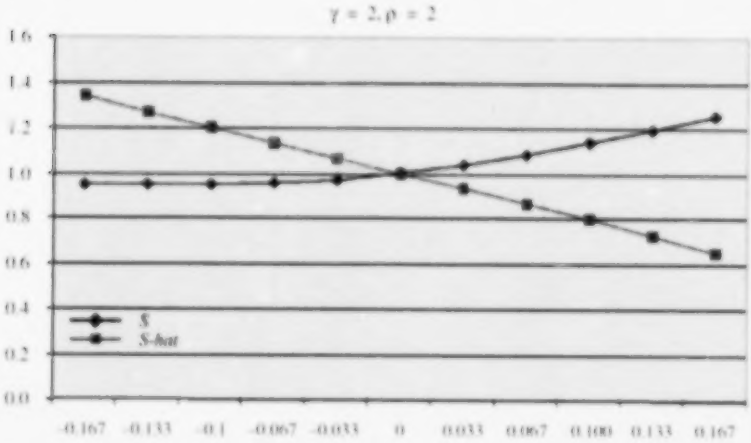
But asset markets are not complete, so the allocations that arise in the presence of the transfer shocks are suboptimal. In fact, when monetary policy is passive, C and C^* can be set at their optimal levels independent of the shock. But employment levels will not be optimal. As we have seen, a positive transfer leads to an appreciation of the domestic currency. This translates into a decline in the relative price of foreign intermediate goods, SP_I^*/P_H, since equations (10) and (11) tell us that P_H and P_I^* will not change with movements in τ when C and C^* do not change. That, in turn, implies that foreign employment will rise and home employment will fall. But when optimal insurance for commodity price shocks is in place, employment would not respond to those shocks.

A second source of inefficiency is the price stickiness of the final consumer goods. As DE emphasize, when final consumer prices are sticky in consumers' currencies, any change in the nominal exchange rate will lead to a change in the price of consumer goods in the home country relative to the foreign country. This is potentially inefficient. An efficient allocation would be obtained only when the relative price change reflects some underlying change in the resource cost of producing the goods.

In this simple model, the resource cost of producing home and foreign consumption goods is identical. Identical production functions combine home and foreign intermediates to produce the consumption good in each country. Therefore, any movement in the consumption real exchange rate is inefficient.

Both of the sources of inefficient allocation point towards exchange rate movements as the transmitter of the distortion. Here, we ask what an optimal, co-operative monetary policy would imply for exchange rate

Figure 4
Exchange rate under optimal and passive monetary policy



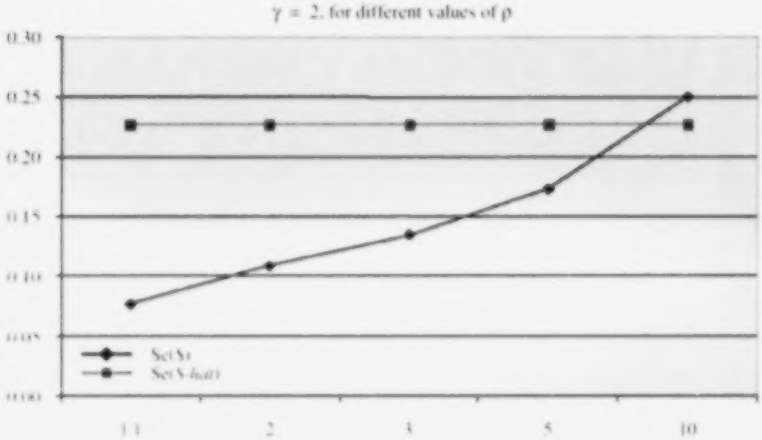
movements. Specifically, we consider monetary policy under commitment, in which policy-makers can precommit to changing C and C^* in response to τ shocks. We solve the model numerically.

Figure 4 plots the exchange rate that would result under optimal policy choices for values of τ. The horizontal axis plots the values of τ equal to zero and $\pm$ 0.033, 0.067, 0.100, 0.133, and 0.167. In this case, we set $\rho = 2$ and $\gamma = 2$. The line labelled "*S*" plots the exchange rate under optimal co-operative policy, while the line labelled "*S-hat*" plots the exchange rate under passive policy.

It is clear from this graph that optimal monetary policy tends to stabilize the exchange rate relative to the passive case. Optimal monetary policy tends to reduce the real exchange rate distortion that occurs when nominal exchange rates fluctuate.

Figure 4 shows that optimal policy pushes the exchange rate in the opposite direction from under passive policy. For example, when there are positive realizations of τ, we find that S rises, in contrast to exchange rate behaviour under passive policy. Optimal policy interventions push C up and C^* down in this case. In turn, from equations (10) and (11), there is an increase in P_H and a decline in P_F^*. The relative price of the foreign intermediate good, SP_F^*/P_H, falls as under passive policy, in spite of the increase in S that occurs under active policy. But the decline in the relative price is less than that which occurs under passive monetary policy. So, optimal policy also

Figure 5
Exchange rate volatility under optimal and passive monetary policy



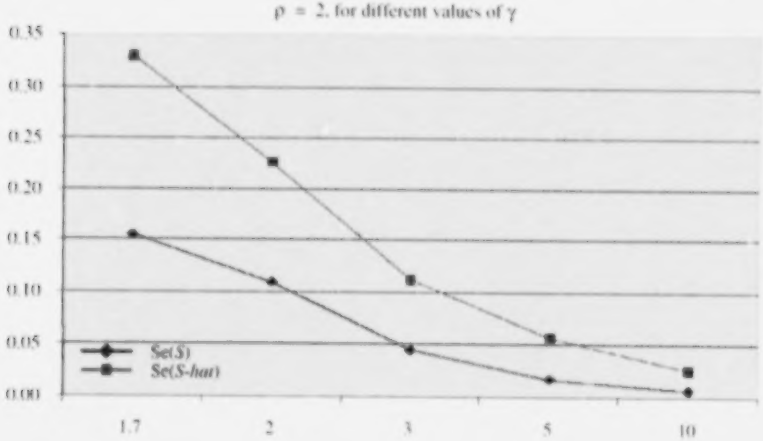
reduces the distortion to employment induced by changes in the relative price of intermediate goods.

Figure 5 plots the standard deviation of the exchange rate (using the distribution of τ values mentioned above) for optimal policy and passive policy as the coefficient of relative risk aversion, ρ, changes. In all cases, we set $\gamma = 2$. The line labelled "Se(*S*)" plots the standard deviation of *S* under optimal policy, while the one labelled "Se(*S-hat*)" plots the standard deviation under passive policy. Except for one case—when ρ is at the very high value of 10—we find that optimal policy stabilizes the nominal exchange rate.

Figure 6 is similar to Figure 5, only we vary the elasticity of substitution between home and foreign intermediate goods, γ, while keeping $\rho = 2$. Here, in all cases, monetary policy stabilizes nominal exchange rates.

The fact that optimal monetary policy under commitment would tend to smooth exchange rate changes lies in contrast to the implications of the classical model. In the classical model, the real exchange rate changes represent optimal movements in the relative prices of non-traded goods. Monetary policy has no role in such a model. But, Chen and Rogoff (2003) argue that there may, in fact, be a role for monetary policy to achieve the optimal relative price adjustments when there is some nominal price stickiness. They ask (2003, 149–50),

Figure 6
Exchange rate volatility under optimal and passive monetary policy



> What if the price of non-traded goods is sticky? Assuming that export prices are flexible with complete pass-through, a simple model of optimal monetary policy would require the exchange rate to accommodate the requisite rise in the relative price of non-traded goods. This implies that the exchange rate should adjust one-for-one with changes in the world price of exportables.

So there is a contrast between the implications for monetary policy of the model presented here and the model of Chen and Rogoff. Our model implies that the exchange rate effects of commodity price changes should be smoothed by monetary policy.

Conclusion

The model presented here is far too simplified to give a definitive answer to how monetary policy in Canada should respond to commodity price shocks. As we have noted, a more realistic model would be dynamic; it would (i) allow for nominal price adjustment; (ii) introduce realistic asset-market assumptions; (iii) explicitly model the commodity market; (iv) allow for the differences in size of Canada and the United States; and (v) allow more general functional forms for preferences and technology.

In addition, we have not considered optimal policy from the perspective of a single country. We have noted only the features of optimal co-operative monetary policy in our model. But that does little to pinpoint the optimal choices for the Bank of Canada, which does not actively co-operate with the Federal Reserve in setting interest rates.

What the model does capture is the fact that real exchange rate movements in the short run—and it is the short run that matters for monetary policy—look more like those that occur under local currency pricing. There is another channel through which a positive commodity shock could lead to a real appreciation in the context of an LCP model.[8] It may be that the nominal exchange rate behaviour of the Canadian dollar is linked to the policy reaction of the Bank of Canada. A positive commodity price increase is expansionary for the Canadian economy. It may be that the Bank of Canada has consistently reacted to this expansion by raising interest rates, and that action, in turn, leads to the appreciation of the Canadian dollar.

It does not appear that the movements in the relative prices of non-traded to traded goods account for much of the real Can$/US$ exchange rate movement, at least in the short run. The actual transmission mechanism from commodity prices to real exchange rates matters for monetary policies. Further investigation is needed to understand the link.

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8. Mick Devereux pointed this out to me.

Engel, C., J.H. Rogers, and S.-Y. Wang. 2004. "Revisiting the Border: An Assessment of the Law of One Price Using Very Disaggregated Consumer Price Data." In *Exchange Rates, Capital Flows and Policy*, edited by R. Driver, P. Sinclair, and C. Thoenissen. London: Routledge.

General Discussion*

Robert Lafrance asked if the presumed exchange rate misalignments in the paper were simply reflecting deviations from purchasing-power-parity (PPP) calculations. He wondered whether nominal exchange rate volatility had major welfare implications, given that Canada-US PPP estimates exhibited only moderate volatility over time. Charles Engel responded that as national prices were not reflecting actual cost differences, this indicated important economic inefficiencies. Nicholas Rowe argued that the data could be reconciled with a simpler model that introduced differentiated transportation costs for goods (low) and services (high) across the border. Engel replied that this merited further thought, but that such a model would still require some form of price stickiness. John Murray wondered if this approach had been tried to explain cross-border price differences with other country pairs. Engel replied no, but that it might be interesting, since the Canadian-US dollar exchange rate was not volatile when compared with other major currencies. Pierre Duguay questioned the role of monetary policy in the model, in particular, in controlling a real variable (i.e., consumption). What monetary policy can actually control is a nominal variable, such as prices. Engel answered that in his highly simplified model, monetary policy ultimately affects real wages and that his static model has no price dynamics.

* Prepared by Robert Lafrance.

Session 5:
Real Linkages:
Canada and the United States

Regional and Industrial Business Cycle Fluctuations in Canada: A North American Perspective

Marc-André Gosselin, René Lalonde, Jean-François Perrault, and Gerald Stuber

Introduction

Conventional wisdom holds that the globalization of markets has had a significant impact on the co-movement or transmission of international business cycles. It is by now widely accepted that a "world" factor contributes importantly to business cycle fluctuations in most countries. Moreover, consistent with the increase in regional integration in Europe and North America, there is evidence of increased synchronization of business cycles within some regions of the world. In North America, this tendency was already well under way prior to the implementation of the Canada-US Free Trade Agreement (FTA) in 1989. The growing linkages between these two economies are often analyzed in the literature in one of two ways: by looking at trends in bilateral trade flows at the regional and sectoral levels, or by analyzing correlations or commonalities in aggregate business cycle fluctuations. In this paper, we combine the two approaches. By formally examining Canadian and US business cycles at the industry and region levels, we provide a rich analysis of the extent to which expansions and recessions in the two economies are linked.

We address this question by analyzing a unique data set of sectoral output for US and Canadian subnational regions. Specifically, we investigate the extent to which disaggregate Canadian business cycle fluctuations are influenced by North American, Canadian, and region-specific variations in sectoral output. To do so, we identify factors that are common to each

industry from North American, Canadian, and regional perspectives, using a state-space approach. We then use the results of this factorization to perform variance decompositions and examine the temporal dimension of our findings.

Dynamic factor models have been popular in the recent literature on business cycle linkages, since they capture every possible dynamic correlation from the data. However, the extracted factors that factor models provide cannot be easily interpreted. Our approach has the advantage of being more intuitive in that the estimated dynamic unobservable components from the state-space approach are derived from structural identifying restrictions.

Six major results emerge from our empirical analysis:

(i) Over the period 1963–2001, the common North American, common Canadian, and region-specific components were all important determinants of business cycle fluctuations in Canada's regions and industries.

(ii) On average, the contribution of the common Canadian component is dominant.

(iii) The share of the variance in Canadian cycles that is common with the United States increased over the sample.

(iv) This increase was at the expense of region-specific shocks, indicating that economic integration could have led to a reduction in cyclical asymmetries across Canada's regions.

(v) Interestingly, the common Canadian component in the manufacturing sector rose, suggesting a Canada-wide increase in specialization in that industry.

(vi) Industrial composition matters: some sectors are much more exposed to North American developments (manufacturing and wholesale and retail trade), others to Canadian developments (other services, construction, and transportation), and others to idiosyncratic shocks (mining; utilities; and agriculture, fishing, and forestry).

Given these findings, the principal policy recommendation resulting from our work stresses economic flexibility, in terms of the structure of the economy, such as factor mobility, but also in terms of the tools used in macroeconomic stabilization policy. In that context, an independent monetary policy framework, characterized by exchange rate flexibility, seems best suited to ensure efficient economic outcomes in Canada.

The first section of this paper reviews recent findings on the importance of the international transmission of business cycles. The second section reviews trends in the Canada-US trading relationship. The third section

presents our data set and empirical methodology, and the fourth discusses our key findings. Before concluding, the final section identifies the main policy implications of our findings.

1 Literature Review

A number of studies have found evidence of a world business cycle. Kose, Otrok, and Whiteman (2003) find that a global cyclical element contributes importantly to output-growth fluctuations in a broad cross-section of industrial and developing countries. Canova, Ciccarelli, and Ortega (2004) obtain similar results for the G-7 industrial economies. Within this group, international business cycles appear to be the most important for the US, Canadian, and UK economies (IMF 2001).

The increase in regional integration has led to the emergence of common cycles within some regions of the world. Evidence for a European business cycle is mixed. Bordo and Helbling (2003) and Stock and Watson (2003) find that there is a tendency towards increased synchronization of business cycles in the Euro-zone economies. However, Kose, Otrok, and Whiteman (2003), as well as Canova, Ciccarelli, and Ortega (2004), do not find evidence of a Euro-area-specific cycle. On the other hand, evidence of a distinct North American business cycle is ample (Stock and Watson 2003; Bordo and Helbling 2003; and others).

Close linkages between the Canadian and US business cycles are widely documented (Ambler, Cardia, and Zimmermann 2004; Helbling and Bayoumi 2003; Otto, Voss, and Willard 2001; Kose, Prasad, and Terrones 2003; Cardarelli and Kose 2004). Bergman, Bordo, and Jonung (1998) find that the correlations of the business cycles of these two countries have been high for over a century. This finding is consistent with other evidence that many countries share a common cycle with their major trading partner (Anderson, Kwark, and Vahid 1999). Bordo and Helbling (2003) find that the correlation of aggregate supply or permanent shocks has risen steadily for the United States and Canada. As well, the share of Canada's output variance explained by a common cyclical factor with the United States is estimated to have tripled between the period from 1960 to 1980 and the subsequent period since the early 1980s (Cardarelli and Kose 2004). On the other hand, Doyle and Faust (2003) show that there has been no statistically significant change in the correlation between Canadian and US real GDP growth since the 1960s. Similar results were found by Helbling and Bayoumi (2003). Overall, the relative importance of common global factors for Canada is generally high in the literature. Table 1 presents ballpark figures from the recent literature for the importance of common and specific

Table 1
Components for Canadian output fluctuations (percentage)

Studies	Common	Specific
Kose, Otrok, and Whiteman (2003)	72	28
Cardarelli and Kose (2004)	10	90
Canova, Ciccarelli, and Ortega (2004)	30	70
Helbling and Bayoumi (2003)	60	40
Bordo and Helbling (2003)	50	50
Stock and Watson (2003)	65	35

components for Canadian output fluctuations, based on samples starting in the early 1960s.

While it is clear that there are tight cyclical linkages between close trading partners, such as the United States and Canada, there is an ongoing debate concerning the key factors that explain these linkages. Frankel and Rose (1998) provide evidence that stronger international trade linkages should lead to increased business cycle correlations.[1] Baxter and Kouparitsas (2004) found a robust relationship between bilateral trade and business cycle co-movements, employing a data set of over 100 countries. However, there remains considerable skepticism among researchers as to whether trade linkages are sufficient in and of themselves to generate the observed output correlations among countries (Bordo and Helbling 2003; Doyle and Faust 2003; IMF 2001). For instance, the similarity of sectoral economic structures may be as important as trade intensity in contributing to the synchronization of business cycles across countries in the OECD (Imbs 2001, 2003).[2] As well, the degree of financial market integration, as explained by such variables as bilateral exchange rate stability and the extent of integration of either equity or bond markets, also seems to contribute to increased bilateral business cycle correlations (Otto, Voss, and Willard 2003). Finally, the similarity of accounting standards and the speed of adoption of new information and communications technologies appear to be important influences on bilateral output-growth correlations (Otto, Voss, and Willard 2001).

1. A more recent study suggests that Frankel and Rose may have considerably overstated the magnitude of this effect (Gruben, Koo, and Millis 2002). Another study supporting a positive and significant link between trade intensity and business cycle correlations is Kose, Prasad, and Terrones (2003).

2. On the other hand, Baxter and Kouparitsas (2004) found in their cross-country study that the similarity of industrial structure was not a robust determinant of business cycle co-movements.

The geographical and sectoral dimensions of fluctuations in economic activity are also important in understanding business cycles, both nationally and internationally. For instance, shocks that significantly affect the allocation of labour and capital across regions and sectors appear to contribute importantly to aggregate economic fluctuations (Schuh and Triest 1998; Davis and Haltiwanger 1999). In the case of the United States, there is evidence that shocks to state economic activity are important in explaining output movements at the national level (Ghosh and Wolf 1997). As well, Horvath (1998, 2000) has concluded that sector-specific shocks, especially those affecting sectors acting as key suppliers of inputs, have accounted for most of the volatility in US GDP growth. Consistent with this result, Barillas and Schleicher (2003) find that manufacturing, the primary industries, and construction are important sources of fluctuations for the Canadian economy. In a study of seven European countries and the United States, it was found that industry-specific and nation-specific shocks contributed significantly to explaining volatility in industrial output growth rates (Stockman 1988). It has been suggested that policies to reduce the economic effects of national borders would likely increase the importance of cross-country and industry-specific shocks relative to that of nation-specific shocks as sources of cyclical fluctuations in economic activity at the national level (Clark and Shin 2000).

In research on the factors influencing cyclical fluctuations in the major Canadian regions, including shocks originating in the United States, DeSerres and Lalonde (1994) find that shocks to Canadian regions are more closely linked to a common Canadian component than to a common component with the United States. Bayoumi and Eichengreen (1993) found that a large share of shocks in Canadian regions are asymmetric relative to those in the United States. (See Dupasquier, St-Amant, and Lalonde (1997) for similar results.) On the other hand, Racette and Raynauld (1994) found evidence that US national economic shocks were particularly important as a source of aggregate output variation in British Columbia, while the economies of Ontario and the Atlantic region were especially sensitive to Canadian national economic shocks. They also found that US regional shocks tended to be more important than shocks originating in other Canadian regions as a source of real variation in a given Canadian region, reflecting the importance of north-south international trade linkages. More recent evidence suggests that real growth in Ontario and Quebec is most highly correlated with that of the US regions and that growth in the US Great Lakes region is the most highly correlated with that of the Canadian regions (Michelis 2004).

While Canada-US business cycle linkages have been analyzed at length from a regional perspective, to our knowledge, there is no study on these

linkages at the sectoral level. This paper extends the existing literature on cross-country economic linkages by focusing on both the sectoral and regional dimensions of the Canada-US economic relationship. Our approach has the advantage of measuring the relative degree of North American integration at the industry level in Canadian regions. Before turning to the empirical analysis, the next section reviews the stylized facts of the Canada-US international trade linkages, with emphasis on developments at the sectoral and regional levels.

2 Canada-US International Trade Linkages: Stylized Facts

Canada's international trade, relative to GDP, has risen markedly since the early 1960s (Figure A1.1, Appendix 1). Moreover, the exposure of the Canadian economy to international trade has surged since the late 1980s, following the implementation of the Canada-US FTA. The substantial rise in the export orientation of the Canadian economy has been limited largely to the United States, as exports to non-US countries (relative to GDP), overall, were little changed in the 1961–2001 period (Figure A1.2). In contrast, the increase in Canadian import market penetration has been more geographically diversified. For instance, the US share of Canada's imports of goods and services has been relatively stable since the early 1960s (Table A1.1).

The increasing orientation of Canada's exports towards the US market, already well under way prior to the implementation of the FTA, has continued since the late 1980s. The rise in the US share of total exports since 1989, while broadly based by product category, has been particularly strong for agricultural products, metals and minerals, and apparel and textiles (Table A1.2). In a few cases (such as transportation equipment), there was little room for further increases in orientation towards the American market, since a very high percentage of Canadian exports was already being shipped to the United States prior to 1989. In contrast, the changes in the US shares of Canada's merchandise imports by product categories since 1989 were generally more modest. There was, however, a marked rise in the US share of Canadian imports of food and beverages over this period.

The rise in the US share of Canadian merchandise exports since 1989 has been evident in all of the major Canadian regions. These increases in US export orientation were largest for British Columbia and the Territories, the Prairie provinces, and the Atlantic region, since these regions had previously had a smaller US export orientation than either Ontario or Quebec (Tables A1.3–A1.7). By major product category and region, the largest

increases in US export orientation were for selected resource-based products: metals and minerals and wood and paper products for British Columbia and the Territories and the Atlantic region, and agricultural products for the Prairie region.

Canada's trade with the United States has tended to be oriented towards particular US regions. For instance, close to half of Canada's international trade with the United States has been concentrated in the Midwest region (Acharya, Sharma, and Rao 2003). Between the 1980–89 and 1995–2000 periods, there was a substantial rise in the share of Canada's merchandise trade with the US South region, concentrated in exports from Canada's Atlantic and Prairie regions and Quebec. On the other hand, over the same period, the share of Canada's goods trade with the US Northeast region decreased markedly, concentrated in exports from the Atlantic region and Ontario.

Part of the increase in international trade exposure represents growing two-way trade in similar products among industrial countries, as well as the increasing importance of imported inputs in the production of exportable products (Acharya, Sharma, and Rao 2003; Dion 1999–2000). Even so, there has been a tendency for the net export intensity of Canadian industries to rise over time (Acharya, Sharma, and Rao 2003; Campa and Goldberg 1997).

3 Data and Methodology

Our goal is to examine the cyclical linkages between the Canadian and US economies at the industrial and regional levels. To do so, we estimate a state-space model in which sectoral business cycle fluctuations are decomposed into a common North American component shared by Canada and the United States, a Canadian component common to all provinces, and an idiosyncratic regional component. A similar approach was used by Chamie, DeSerres, and Lalonde (1994) to examine optimal currency areas in Europe and the United States.

To estimate the model, we use data on regional output at the sector level. For Canada, we use Conference Board data on provincial GDP, while for the United States, we use Bureau of Economic Analysis (BEA) data on gross state product. Our data set is annual and spans from 1963 to 2001. It covers the following 10 sectors: agriculture, fishing, and forestry (AF); mining (MI); manufacturing (MF); construction (CN); transportation and communications (TC); utilities (UT); wholesale and retail trade (WR); finance, insurance, and real estate (FI); other services (SE); and government (GV). Canadian provinces were grouped into five regions: Atlantic (AT),

Quebec (QC), Ontario (ON), Prairies (PR), and British Columbia (BC); US states were grouped into eight economic regions, as in Crone (2003): Northeast (NE), Mid-Atlantic (MA), South (SO), Great Lakes (GL), Plains (PL), Mountains (MN), Southwest (SW), and Far West (FW).[3]

For each of the 10 industries, the measurement equation is specified as follows:

$$\begin{bmatrix} Y_t^{NE} \\ Y_t^{MA} \\ Y_t^{SO} \\ Y_t^{GL} \\ Y_t^{PL} \\ Y_t^{MN} \\ Y_t^{SW} \\ Y_t^{FW} \\ Y_t^{AT} \\ Y_t^{QC} \\ Y_t^{ON} \\ Y_t^{PR} \\ Y_t^{BC} \end{bmatrix} = \begin{bmatrix} h_{1,1} & 0 & & & & & & & & & & & \\ h_{2,1} & 0 & & & & & & & & & & & \\ h_{3,1} & 0 & & & & & & & & & & & \\ h_{4,1} & 0 & & & & & & & & & & & \\ h_{5,1} & 0 & & & & & & & & & & & \\ h_{6,1} & 0 & & & & & & & & & & & \\ h_{7,1} & 0 & & & & & I_{13\times13} & & & & & & \\ h_{8,1} & 0 & & & & & & & & & & & \\ h_{9,1} & h_{9,2} & & & & & & & & & & & \\ h_{10,1} & h_{10,2} & & & & & & & & & & & \\ h_{11,1} & h_{11,2} & & & & & & & & & & & \\ h_{12,1} & h_{12,2} & & & & & & & & & & & \\ h_{13,1} & h_{13,2} & & & & & & & & & & & \end{bmatrix} \begin{bmatrix} Z_t^{NA} \\ Z_t^{CAN} \\ Z_t^{NE} \\ Z_t^{MA} \\ Z_t^{SO} \\ Z_t^{GL} \\ Z_t^{PL} \\ Z_t^{MN} \\ Z_t^{SW} \\ Z_t^{FW} \\ Z_t^{AT} \\ Z_t^{QC} \\ Z_t^{ON} \\ Z_t^{PR} \\ Z_t^{BC} \end{bmatrix}. \tag{1}$$

where the vector Y contains the HP-filtered cyclical component of each region's output, and the vector Z contains the orthogonal unobservable common North American and Canadian components, as well as 13 region-specific components. The coefficients in the state matrix H provide a measure of how strongly regional business cycles are related to the common

3. See Appendix 5 for additional details on the construction of this data set, as well as descriptive statistics.

components. Given that our focus is on Canadian regions, we do not attempt to identify a distinct common US component. Such a variable would likely be redundant given the disproportionate importance of the US economy in North America.

The transition equation specifies the dynamic behaviour of the unobservable variables (Z). Assuming that these variables follow an AR(1) process, we have:

$$Z_t = FZ_{t-1} + e_t, \text{ where}$$

$$E(e_t e_t') = Q = \begin{bmatrix} 1 & & & & & \\ & 1 & & & & \\ & & Q_{3,3} & & & \\ & & & \cdot & & \\ & & & & \cdot & \\ & & & & & \cdot \\ & & & & & & Q_{13,13} \end{bmatrix}. \tag{2}$$

For purposes of identification, the unobservable components are assumed to be uncorrelated. The scale of the variables is standardized by setting the variance of the common North American and Canadian components to unity.[4] A total of 10 state-space models are estimated, one for each industry. The unobservable components, Z, are generated by the Kalman filter with estimates of H, F, and Q given by maximum likelihood using the integrated EM/scoring algorithms.[5]

We then assess the relative importance of the common and specific factors by carrying out variance decompositions of regional business cycles. The decomposition is calculated from the estimated variance of shocks affecting each of the 13 regions (i). From equations (1) and (2), it follows that

$$Y_t^i = H_{i,1}Z_t^{NA} + H_{i,2}Z_t^{CAN} + Z_t^i$$

and that

4. This standardization is used only to simplify the calculations. It is neutral on the variance decompositions, since the unrestricted h coefficients (columns 1 and 2) simply adjust accordingly.

5. With an all-industry North American state-space model containing all 130 series, we would be able to identify industry-specific shocks. However, such a model would contain a very large number of parameters (many hundreds), which would complicate the estimation process greatly.

$$var(Y_t^i) = \frac{H_{i,1}^{\ 2}}{1 - F_{1,1}^{\ 2}} + \frac{H_{i,2}^{\ 2}}{1 - F_{2,2}^{\ 2}} + \frac{Q_{i+2,i+2}^{\ 2}}{1 - F_{i+2,i+2}^{\ 2}}.$$

The first element of this sum represents the contribution of the North American factor to total business cycle variance in region i. The second term measures the contribution of the Canadian component, while the third term captures the contribution of region-specific factors. It is worth noting that we do not attempt to identify the source or nature of shocks. Rather, the purpose of the model is to perform a geographical classification of disturbances as affecting either all North American regions, all Canadian regions, or only one region. Before turning to results, we review the possible interpretations for each of these components.

The North American factor measures the component of the business cycle that Canada shares with the United States.[6] A strong North American component in terms of variance decomposition has two possible interpretations: (i) a high degree of North American market integration; or (ii) a similar reaction/exposure to common shocks. It is important to note that this component may not be specific to the North American region, since it can also reflect a common response of Canada and the United States to global disturbances.[7] For example, an oil-price shock could be captured by the North American component.

The Canadian factor captures the portion of the regions' business cycles that is entirely Canadian, i.e., common to all Canadian regions for the industry under examination and orthogonal to the United States. Industries affected by a common national regulation or provinces requiring higher federal transfers will increase the importance of the common Canadian component. This component also has the same two interpretations as the North American component, but at the Canadian level. For example, a fiscal-policy shock at the federal level could be captured by the Canadian component.

The regional factor measures the component of the cycle that is specific to a region. Important regional elements have two possible explanations: (i) the industry under study is highly concentrated in that region (specialization); or (ii) region-specific shocks occurred frequently over the sample (e.g., bad weather, strikes, provincial government policies, immigration). For

6. For the US series, this factor captures both US-specific national factors, as well as North American factors.

7. This is not likely, however, given the results of Kose, Otrok, and Whiteman (2003) and Stock and Watson (2003), who find an important North American regional factor in a broader context.

example, a sudden decline in fish stocks on the west coast will be captured by the component relating to British Columbia.

4 Empirical Results

Summary tables for the variance decompositions are presented in Appendixes 2 and 3 for Canada and the United States, respectively. We present results based on a regional and industrial aggregation.[8] This aggregation is a complex combination involving weights based on both the relative levels of the output series as well as the relative variances of cyclical components. Thus, although a given sector can represent only a small share of output, its contribution will be large if the relative variance of its business cycle is large.

Over the period 1963–2001, our results show that the common North American, Canadian, and region-specific components were important determinants of sectoral cyclical variations in Canada. Our findings generally confirm the results obtained in previous studies suggesting that external disturbances are an important determinant of Canadian business cycle fluctuations. On average, these shocks explain about 32 per cent of regional business cycle variations in Canada. As previously identified, this component captures developments in the economy at large, whether they are North American or not.[9] This result is consistent with results of Gregory, Head, and Raynauld (1997); Chamie, DeSerres, and Lalonde (1994); Canova, Ciccarelli, and Ortega (2003); and Cardarelli and Kose (2004). However, our findings diverge somewhat from recent studies by Kose, Otrock, and Whiteman (2003) and Helbling and Bayoumi (2003) that suggest that external factors account for a much larger share of cyclical variations in Canada (see section 2). On a regional basis, not surprisingly, it is in Quebec and Ontario that the North American factor is the most important, with shares of 24 and 37 per cent, respectively. Ontario is the only province where common North American disturbances dominate. At the other extreme, only 4.1 per cent of cyclical fluctuations in the Prairies region are common with the United States. On a sectoral basis, again not surprisingly, it is in the manufacturing and trade sectors that the common North American factor is the highest, with shares of 52 and 33 per cent, respectively. The utilities and primary sectors are the least integrated with the United States.

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8. See Appendix 4 for the complete results at the industry-region level in Canada. Detailed results for the United States are available from the authors.

9. The identifying assumption is that this component is orthogonal to all other factors, including the Canadian sector-specific element.

Common Canadian disturbances are the most important contributors to cyclical variations in Canada. With an average share of 38 per cent, this component is important in all Canadian regions. It is the highest in the "other services" sector, which is not surprising, given that this sector is mostly public. On an industry basis, except for the agriculture, fishing, and forestry sector, the large share for the common Canadian component is broad-based. It is highest in the "other services" and finance, insurance, and real estate (FIRE) sectors and lowest in the utilities and primary sectors.

We find that idiosyncratic disturbances account for a non-negligible proportion of 30 per cent of the total variation in provincial business cycles. From both a Canadian and North American persective, the Atlantic, Prairies, and BC regions are the least economically integrated, since most of the variance of the business cycle in these regions is explained by idiosyncratic shocks. This result is attributable mainly to the agriculture, fishing, and forestry sector. As expected, cycles in the utilities and primary sectors are the most idiosyncratic. The results for the agriculture, fishing, and forestry sector, in which almost 93 per cent of the variance is idiosyncratic, may appear at odds with one's priors, given the tradable nature of these goods. This probably reflects weather-related supply shocks. Another explanation could be the segmented nature of agricultural markets in Canada. These markets were characterized by federal and provincial supply-management programs over most of our sample period.[10] In many respects, the same logic applies to the utilities sector, since one would expect that utility output would be highly regional in nature, reflecting the segmented structure of the industry.[11] These results highlight the importance of accounting for regional and sectoral differences in business cycle dynamics.

To evaluate the impact of the tendency towards economic integration over the sample, we re-estimate the models over the period 1982–2001. These results indicate an increase in the average contribution of the common North American component from 32 to 38 per cent. While broad-based, the increase is most evident in the Atlantic and BC regions. This is consistent with the stylized facts suggesting a convergence in trade openness towards the Ontario and Quebec levels. Ontario is still the only province where common North American disturbances dominate. From a sectoral perspective, the increase of the North American factor is broad-based. The only

10. See Palda (1994) for a review of Canadian interprovincial barriers to trade.

11. In Canada, utilities are generally owned, and all regulated, by provincial authorities, with limited interprovincial trading abilities. Consequently, excess capacity in one province has little effect on neighbouring provinces.

exception is the manufacturing sector, where the contribution of this factor fell by 10 percentage points.[12]

The reduction in North American synchronization of cycles in the manufacturing sector since 1982 could be due to outsourcing activities from the manufacturing sector towards the wholesale and retail trade sector. It could also be explained by an increase in specialization in Canada's regions following the expansion in trade openness with the United States. It is important to note, however, that it is the common Canadian component—and not the regional components—that benefited from this reduction. Consequently, for this explanation to hold, the increase in manufacturing specialization must have been similar across all Canadian regions. Also, results show that the increase in the contribution of the common Canadian component is not due to a rise in the exposure of manufacturing cycles to this component (the *h* coefficients). Rather, it is explained by an increase in the relative persistence of common Canadian cycles (the *F* coefficient). This suggests a slower speed of adjustment in the manufacturing sector since 1982. Is this due to an increase in price or wage rigidity or to a slow adjustment in the industrial structure of this sector following globalization?[13] We leave this to future research.

Consistent with the stylized facts, we find that the contribution of the North American factor increases in the trade and primary sectors. Interestingly, the contribution of the North American component also increased in sectors with little or no tradable content. In the case of the FIRE sector, the rise probably reflects the increasing integration of Canadian and US financial markets. The increase in the construction sector could be explained by a greater symmetry in interest rate movements on both sides of the border. With respect to cycles in the utilities sector, the greater share of the North American component is concentrated in Quebec. This may be due to the increasing importance of electricity exports.

On average, results indicate that symmetry in Canadian regional cycles remains high, with a contribution of the common Canadian component of 40 per cent. This component rose in all regions but the Prairies. In that region, business cycles have become mostly idiosyncratic, and this is mainly due to the mining sector. Region-specific shocks decreased significantly in British Columbia and the Atlantic region. The average contribution of

12. Otherwise, the common North American component would have increased significantly more, given the importance of the manufacturing industry in the variance of the cycle in total output.

13. Beine and Coulombe (2004) find that industrial concentration ratios are roughly unchanged over the past twenty years. This might suggest that the manufacturing sector has been relatively sluggish in its response to open borders compared with other industries.

regional factors fell from 30.4 to 21.6 per cent. Roughly three quarters of this reduction translates into an increase in the share of the North American factor. With the exception of the mining sector, results show a significant reduction in the regional component in most industries.[14]

Given that we do not identify a distinct common US component, the cyclical variations in the US regions are decomposed into a common North American component as well as into region-specific elements. From a US perspective, therefore, the North American factor is the common US component. Results for the United States show that cyclical variations are largely symmetric across regions and industries. On average, 68.3 per cent of the variance of US business cycles is due to the North American component. The least integrated regions are the Northeast and the Mountains, while the most integrated are the Great Lakes and the South. At the industry level, the cycles in the manufacturing, mining, and government sectors are largely symmetric, while the utilities and FIRE sectors are mostly idiosyncratic. Results for the post-1982 period show that the average decomposition for the United States as a whole is virtually unchanged. Economic integration has led to a significant increase in the share of the North American component only in the Northeast, Mid-Atlantic, and Far West regions. An increase in region-specific shocks, probably due to specialization, occurred in the other regions. With the exception of the FIRE sector, variance decompositions are essentially unchanged at the industry level.

5 Policy Implications

Given our findings, which suggest that North American, Canadian, and region-specific shocks are all important determinants of provincial business cycles, our main policy recommendation stresses economic flexibility, both in terms of the actual economic structure of the economy, such as factor mobility, but also in terms of the tools used in macroeconomic stabilization policy.

Our finding of a sizable common Canadian factor in both regional and industrial business cycle variations argues forcefully in favour of an independent Canadian monetary policy characterized by a flexible exchange rate. A flexible exchange rate buffers external shocks, allowing the economy to adjust more easily to disturbances. Almost equally important, the real exchange rate is also a measure of the relative price of tradables to non-tradables. Allowing it to float sends signals to economic agents about the

14. The result for the mining sector probably relates to the growing importance of natural gas production over this period. This sector is highly influenced by weather shocks.

relative health of their industries, and thus encourages a more efficient allocation of resources.

Note that the importance of region- and/or sector-specific disturbances poses a challenge for monetary policy. Over the full sample, idiosyncratic shocks account for about 30 per cent of cyclical variations. However, we find that the Canadian factor has remained significant, and the idiosyncratic effect has become less important in the more recent sample. Thus, there is evidence that Canada satisfies the optimal currency-area criteria more so now than in the past, although the Canadian economy continues to importantly share a common cycle with its trading partners.

The relative importance of region- and sector-specific factors in explaining provincial business cycle fluctuations necessitates a delicate balance between regional fiscal stabilization policies and those that promote factor mobility. In Canada, fiscal stabilization policies operate at both the federal and provincial levels. The federal equalization program, which transfers fiscal resources from wealthier provinces to those in need, reduces the vulnerability of provincial finances to idiosyncratic shocks (Bayoumi and Masson 1995), while providing a continuity of resources to fund health and education. The federal government also administers the employment insurance system, which provides extended benefits to workers in some seasonal industries, such as fishing. At the provincial level, Canadian provinces can run countercyclical fiscal policies to offset region-specific economic disturbances.

On the other hand, idiosyncratic shocks also argue strongly in favour of policies that promote factor mobility. Two such impediments are interprovincial trade restrictions and disincentives to labour mobility. Barriers to interprovincial trade are well documented in Canada (Palda 1994). Not only have they tended to insulate Canadian provinces from shocks in other provinces, but they have also acted to slow the transfer of capital resources from one sector to another. In addition, the federal transfer system, which ensures equal access to essential services across Canada, has likely reduced the opportunity costs of remaining in a region or industry that is underperforming.[15] As well, the Canadian employment insurance system affects labour mobility by discouraging workers in contracting and/or seasonal industries from seeking employment in other regions.[16] Our results suggest that policies aimed at facilitating the transfer of resources from contracting

15. The rationale for the federal equalization program is not purely economic. To a large degree, the program is motivated by a desire for social cohesion among all Canadian regions.

16. Clearly, some of these factors have structural dimensions that may not necessarily be captured in the cyclical position of the economy, as is used in this paper.

to expanding industries may lead to a reduction in business cycle variations at the regional and national levels, particularly in an era of increasing globalization.

On this note, our results are somewhat encouraging. Structural reforms have been put in place in the past decade (the employment insurance legislation of 1996, which made payments a function of the intensity of use, and the 1995 Agreement on Internal Trade) that have increased the Canadian economy's ability to respond to shocks. Such reforms may underlie our finding that the idiosyncratic component of regional business cycles is significantly lower in the most recent sample than over the full period. The significant reduction in region-specific shocks in the 1982–2001 period argues less forcefully in favour of regional stabilization policies.[17]

Conclusion

This paper investigates the regional dimension of business cycle variations, using a unique data set of sector- and region-specific output series for North America. Common industrial factors are identified at the North American, Canadian, and regional levels, using a state-space approach. Six major results emerge from our empirical analysis:

(i) Over the period 1963–2001, the common North American, common Canadian, and region-specific components were all important determinants of business cycle fluctuations in Canada's regions and industries.

(ii) On average, the contribution of the common Canadian component is dominant.

(iii) The share of the variance in Canadian cycles that is common with the US increased over the sample.

(iv) This increase was at the expense of region-specific shocks, indicating that economic integration could have led to a reduction in cyclical asymmetries across Canada's regions.

(v) Interestingly, the common Canadian component in the manufacturing sector rose, suggesting a Canada-wide increase in specialization in that industry.

(vi) Industrial composition matters: some sectors are much more exposed to North American developments (manufacturing and wholesale and retail trade), others to Canadian developments (other services, construction,

17. Of course, the direction of causality is unclear. Are regional shocks less important because regional diversification and stabilization policies work? Or are these shocks simply becoming less important? Further research is needed to determine the answer.

and transportation), and others to idiosyncratic shocks (mining; utilities; and agriculture, fishing, and forestry).

Our findings are best interpreted qualitatively, given uncertainty around the estimated variance decompositions. Future work will focus on comparing our post-1982 findings with pre-1982 results, calculating confidence bands on the estimated decompositions, as well as performing additional robustness checks. An additional avenue for future research is examining regional linkages, such as the north-south dimension. Nevertheless, based on our results, the principal policy prescription is to encourage economic flexibility, both in the economy's ability to respond to macroeconomic shocks through fiscal and monetary policies, but also by reducing impediments to factor mobility. In addition, our results provide evidence that the Canadian economy may better satisfy the requirements for an optimal currency area in the 1982–2001 period, since idiosyncratic shocks have become significantly less important determinants of regional business cycles.

Appendix 1
Stylized Facts

Figure A1.1
Canada's international trade as a percentage of GDP

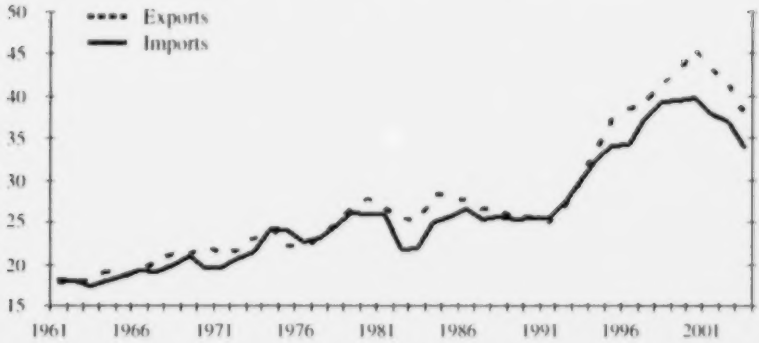

Figure A1.2
Canada's exports as a percentage of GDP

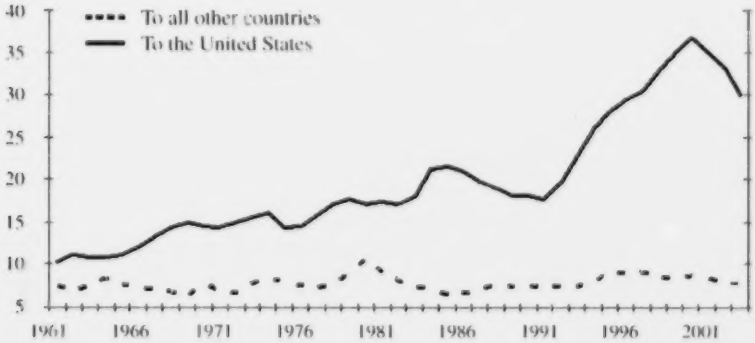

Table A1.1
Canada's bilateral trade with the United States

	1961	1975	1988	2003
US share of Canadian exports of goods and services (%)	58.0	64.7	71.8	79.7
US share of Canadian imports of good and services (%)	67.1	66.3	68.3	68.4
Canadian exports to US relative to total GDP (%)	10.3	14.4	19.1	30.0
Canadian imports from US relative to total GDP (%)	12.2	16.0	17.7	23.0

Source: Statistics Canada, National Income and Expenditure Accounts, balance of payments.

Table A1.2
US share of Canada's merchandise trade for major product categories

	Exports		Imports	
	1989	2002	1989	2002
Agriculture	35.2	59.4	62.6	61.4
Food and beverages	75.0	91.2	42.4	62.1
Metals and minerals	69.4	90.1	53.6	50.7
Chemicals	66.7	78.7	64.8	64.7
Plastics and rubber products	81.5	94.8	77.0	80.7
Apparel and textiles	56.3	87.1	27.5	31.8
Wood and paper	65.0	80.8	83.0	81.7
Machinery and electronics	78.6	83.2	67.3	61.3
Transportation equipment	95.1	94.4	78.8	72.9
Miscellaneous manufactures	90.2	94.3	48.3	43.1

Sources: Statistics Canada, customs basis.
Department of Foreign Affairs and International Trade (Canada), *NAFTA @ 1: A Preliminary Report*.

Table A1.3
US share of merchandise trade, British Columbia and Territories (percentage)

	1989	2002
Total exports	40.8	66.7
Selected products		
Metals and minerals	24.5	60.9
Wood and paper	45.1	65.7
Machinery and electronics	74.3	78.6
Total imports	43.1	37.6
Selected products		
Metals and minerals	51.6	52.4
Machinery and electronics	50.7	37.8
Transportation equipment	26.7	18.9

Sources: Statistics Canada, customs basis.
Department of Foreign Affairs and International Trade (Canada), *NAFTA @ 10: A Preliminary Report*.

Table A1.4
US share of merchandise trade,
Prairie region (percentage)

	1989	2002
Total exports	66.8	83.1
Selected products		
Agriculture	22.8	47.4
Metals and minerals	89.2	97.1
Machinery and electronics	80.8	75.6
Total imports	84.3	75.6
Selected products		
Metals and minerals	85.9	84.5
Machinery and electronics	85.8	73.9
Transportation equipment	97.7	67.7

Sources: Statistics Canada, customs basis.
Department of Foreign Affairs and International Trade (Canada), *NAFTA @ 10: A Preliminary Report.*

Table A1.5
US share of merchandise trade,
Ontario (percentage)

	1989	2002
Total exports	85.5	93.5
Selected products		
Metals and minerals	75.1	88.5
Plastics and rubber	80.4	94.9
Wood and paper	94.5	96.3
Machinery and electronics	82.0	86.4
Transportation equipment	97.0	96.8
Total imports	76.0	72.5
Selected products		
Metals and minerals	78.3	78.5
Chemicals	72.1	69.6
Plastics and rubber	85.7	86.7
Machinery and electronics	71.2	63.8
Transportation equipment	92.7	86.7

Sources: Statistics Canada, customs basis.
Department of Foreign Affairs and International Trade (Canada), *NAFTA @ 10: A Preliminary Report.*

Table A1.6
US share of merchandise trade, Quebec (percentage)

	1989	2002
Total exports	71.7	84.0
Selected products		
Metals and minerals	67.9	85.8
Wood and paper	79.0	88.4
Machinery and electronics	69.4	78.4
Transportation equipment	83.9	80.0
Total imports	45.0	37.2
Selected products		
Chemicals	50.9	43.5
Machinery and electronics	54.8	52.5
Transportation equipment	77.7	53.4

Sources: Statistics Canada, custom basis.
Department of Foreign Affairs and International Trade (Canada), *NAFTA @ 10: A Preliminary Report*.

Table A1.7
US share of merchandise trade, Atlantic region (percentage)

	1989	2002
Total exports	64.6	83.5
Selected products		
Agriculture	69.0	68.4
Metals and minerals	71.3	91.3
Wood and paper	53.4	76.2
Total imports	25.5	22.7
Selected products		
Agriculture	34.5	55.3
Metals and minerals	8.2	8.2
Machinery and electronics	45.2	45.6

Sources: Statistics Canada, customs basis.
NAFTA @ 10: A Preliminary Report.

Appendix 2
Summary of Results for Canada[1]

Table A2.1
Canadian variance decomposition: by region
(percentage of total variance)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	8.2	19.7	72.1	26.8	36.4	36.8
Quebec	23.5	55.7	20.8	27.7	60.8	11.5
Ontario	37.3	35.7	26.9	46.1	38.4	15.6
Prairies	4.1	35.8	60.1	8.3	24.0	67.8
British Columbia	12.3	30.7	57.0	26.0	37.7	36.2
Weighted average	31.6	38.0	30.4	38.0	40.4	21.6

Table A2.2
Canadian variance decomposition: by industry
(percentage of total variance)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Manufacturing	51.6	26.6	21.8	41.8	43.6	14.6
Other services	11.3	58.0	30.7	24.3	59.0	16.6
Wholesale and retail trade	33.2	45.8	21.0	55.1	30.9	14.0
Finance, insurance, and real estate	7.7	47.1	45.2	38.8	28.7	32.5
Transportation and communications	11.3	43.8	44.9	9.9	68.9	21.1
Mining	3.4	44.2	52.4	14.1	0.0	85.9
Agriculture, fishing, and forestry	1.5	6.0	92.5	3.9	4.9	91.3
Utilities	1.6	30.0	68.3	9.5	26.8	63.7
Construction	9.1	54.6	36.3	33.2	28.9	37.9
Government	12.0	48.8	39.2	35.9	36.2	28.0
Weighted average	31.6	38.0	30.4	38.0	40.4	21.6

1. Results in this appendix are based on weighted averages of variance decompositions at the region and sector levels (based on disaggregate results from Appendix 4). These averages are a function of the relative size of each sector and region in terms of both levels and variances.

Appendix 3
Summary of Results for the United States

Table A3.1
US variance decomposition: by region
(percentage of total variance)

	North America	Regional	North America	Regional
	1963–2001		1982–2001	
Northeast	40.9	59.1	75.2	24.8
Mid-Atlantic	49.1	50.9	86.7	13.3
South	82.8	17.2	86.9	13.1
Great Lakes	88.3	11.7	79.9	20.1
Plains	74.1	25.9	69.2	30.8
Mountains	47.5	52.5	49.8	50.2
Southwest	67.8	32.2	53.1	46.9
Far West	49.9	50.1	68.5	31.5
Weighted average	68.3	31.7	68.3	31.7

Table A3.2
US variance decomposition: by industry
(percentage of total variance)

	North America	Regional	North America	Regional
	1963–2001		1982–2001	
Manufacturing	79.9	20.1	76.2	23.8
Other services	63.9	36.1	70.5	29.5
Wholesale and retail trade	63.8	36.2	62.1	37.9
Finance, insurance, and real estate	21.9	78.1	42.9	57.1
Transportation and communications	59.1	40.9	59.6	40.4
Mining	91.7	8.3	91.7	8.3
Agriculture, fishing, and forestry	70.3	29.7	71.0	29.0
Utilities	44.0	56.0	40.5	59.5
Construction	54.6	45.4	52.3	47.7
Government	91.1	8.9	90.5	9.5
Weighted average	68.3	31.7	68.3	31.7

Appendix 4
Complete Results for Canada[1]

Table A4.1
Manufacturing variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	24.0	57.2	18.8	11.7	79.9	8.4
Quebec	34.4	59.9	5.7	23.0	69.2	7.9
Ontario	55.3	20.5	24.2	46.2	38.3	15.4
Prairies	22.3	28.3	49.4	24.5	16.8	58.7
British Columbia	27.3	57.5	15.2	18.5	70.8	10.7

Table A4.2
Other services variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	3.8	56.7	39.5	22.0	49.4	28.6
Quebec	17.2	45.2	37.6	32.1	56.3	11.6
Ontario	11.9	66.5	21.6	29.3	63.7	6.9
Prairies	0.1	40.2	59.7	1.6	80.6	17.8
British Columbia	0.6	11.9	87.4	2.2	1.4	96.5

Table A4.3
Wholesale and retail trade variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	32.7	59.0	8.4	53.3	37.4	9.3
Quebec	41.4	55.0	3.6	48.0	49.9	2.1
Ontario	35.2	48.5	16.3	63.9	29.7	6.4
Prairies	10.5	15.6	73.9	23.2	0.0	76.8
British Columbia	11.6	22.6	65.8	29.3	0.0	70.7

1. Complete results for the US regions are available from the authors.

Table A4.4
Finance, insurance, and real estate variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	2.7	74.7	22.6	5.1	59.8	35.1
Quebec	0.7	63.4	36.0	0.6	67.7	31.7
Ontario	11.0	53.2	35.8	48.8	26.7	24.5
Prairies	1.5	15.1	83.4	9.1	11.6	79.2
British Columbia	0.1	15.5	84.4	53.4	26.7	19.9

Table A4.5
Transportation and communications variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	5.6	66.9	27.5	9.5	83.3	7.2
Quebec	17.8	59.9	22.3	13.1	71.1	15.8
Ontario	8.8	44.1	47.0	5.3	84.5	10.1
Prairies	8.2	23.6	68.2	6.1	25.1	68.8
British Columbia	22.4	22.0	55.6	34.3	23.9	41.8

Table A4.6
Mining variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	3.8	14.9	81.3	20.0	0.0	80.0
Quebec	0.1	35.5	64.4	27.7	0.0	72.3
Ontario	1.0	32.6	66.4	0.3	0.0	99.7
Prairies	4.1	47.6	48.3	15.1	0.0	84.9
British Columbia	6.9	64.0	29.1	1.4	0.0	98.6

Table A4.7
Agriculture, fishing, and forestry variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	1.6	82.1	16.2	0.8	87.2	12.0
Quebec	0.0	58.1	41.9	0.0	51.1	48.9
Ontario	0.0	0.0	100.0	6.4	0.0	93.6
Prairies	2.0	1.6	96.4	2.7	0.2	97.1
British Columbia	0.4	0.1	99.5	7.0	4.6	88.5

Table A4.8
Utilities variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	7.4	37.4	55.2	21.7	10.6	67.6
Quebec	0.8	37.0	62.2	36.3	67.7	4.0
Ontario	1.2	11.5	87.3	0.9	19.7	79.4
Prairies	2.0	37.5	60.5	4.1	18.4	77.5
British Columbia	1.2	40.3	58.5	11.9	9.7	78.4

Table A4.9
Construction variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	4.9	0.0	95.1	30.6	23.1	46.3
Quebec	2.6	49.0	48.4	41.1	29.5	29.4
Ontario	11.0	58.9	30.1	74.2	11.1	14.7
Prairies	0.2	55.6	44.2	0.1	45.4	54.5
British Columbia	6.6	8.3	85.1	38.2	13.9	47.9

Table A4.10
Government variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	1.4	53.4	45.2	20.7	52.5	26.8
Quebec	0.2	49.3	50.5	36.0	51.4	12.6
Ontario	17.0	48.4	34.6	44.0	28.9	27.1
Prairies	11.1	49.2	39.6	5.8	29.8	64.4
British Columbia	4.3	50.2	45.5	1.5	52.5	46.0

Appendix 5
Data Set Construction and Descriptive Statistics

To construct the 1963–2001 gross state product (GSP) data set, two different BEA series were used. 1977–2001 data were obtained directly from the BEA (<http://www.bea.gov/bea/regional/gsp>). 1963–1986 data, although also generated by the BEA, were obtained from the RAND Corporation (<http://www.rand.org/labor/aging/dataprod/cdl/listdata.html>). The BEA had removed these data from their website, because "GSP estimates (for years before 1977) were based upon data and methodologies that make them inconsistent with the current GSP series." Since the two series overlapped for nine years (1977–1986), however, they could be compared and spliced together. For each industry, a regression (with intercept 0) was used to predict the "new series" GSP numbers for each state during this nine-year period, using only the "old series" GSP numbers. The following statistics were obtained:

Name	SIC	Coefficient	R-squared
Agriculture, forestry, fishing	10000	0.8986337	0.9940058
Mining	30000	1.0786877	0.9921311
Construction	40000	1.0052937	0.9890694
Manufacturing	50000	0.9986042	0.9963753
Transportation	62000	0.9882547	0.9873658
Communications	64000	1.0296502	0.9981840
Utilities	66000	0.9931251	0.9920840
Wholesale	70000	1.0210251	0.9993343
Retail	80000	1.0173764	0.9995911
FIRE	90000	1.1260956	0.9861843
Other services	100000	1.0240287	0.9999258
Government	110000	1.1450106	0.9994801

Several of the coefficients are statistically different from 1, but the very high R-squared values show that while the older series may not be identical to the newer series, it is measuring essentially the same values. To calculate values for the overall 1963–2001 series, the following method was used:

1963–1976: Values from the "old series" were multiplied by the appropriate coefficient from the above table.

1977–1986: Values from the "new series" were given a weight of 1 in 1977, 2 in 1978, and so on up to 10 in 1986. Values from the "old series" were given a weight of 10 in 1977, 9 in 1978, and so on down to 1 in 1986.

The final value was computed as ((new_series * new_series_weight) + (coefficient * old_series * old_series_weight)) / 11.

1987-2001: Values from the "new series" were used directly.

Next, industries were selected from the data so that the resulting series would cover the same industries in both the United States and Canada:

ID	Name
AF	Agriculture, fishing, and forestry
MI	Mining (including oil and natural gas extraction)
CN	Construction
TC	Transportation and communications
UT	Utilities
WR	Wholesale and retail trade
FI	Finance, insurance, and real estate
SE	Other services (including education and health services)
GV	Government (public administration and defence)

Finally, provinces were grouped as follows:

ID	Provinces
AT	Newfoundland, Prince Edward Island, Nova Scotia, New Brunswick
PQ	Quebec
ON	Ontario
PR	Manitoba, Saskatchewan, Alberta
BC	British Columbia

and US states were grouped into the economic regions developed by Crone (2003):

Note: SIC (Standard Industrial Classification) code.

ID	States
NE	ME, NH, VT, MA, RI, CT
MA	NY, NJ, PA, DE, MD
SO	VA, NC, SC, GA, FL, KY, TN, AL, MS, AR
GL	WV, MI, OH, IN, IL, WI, MN
PL	MO, KS, NE, IA
MN	SD, ND, MT, ID
SW	LA, WY, UT, CO, TX, OK, NM
FW	AZ, CA, NV, WA, OR

Table A5.1
Industry shares (percentage)

	Canada		United States	
	1963	2001	1963	2001
MI	5.4	3.5	2.4	1.4
MF	18.2	18.1	27.7	14.4
CN	8.7	5.3	4.8	4.8
AF	6.3	2.2	3.3	1.4
TC	5.5	8.8	6.5	6.0
WR	8.1	11.2	16.5	16.3
FI	13.3	19.8	16.1	20.9
SE	23.0	22.7	10.7	22.5
GV	9.3	5.6	12.0	12.3
UT	2.1	2.7	2.6	2.2

Table A5.2
Industry shares (percentage of provincial output, 1963–2001)

	AF	MI	MF	CN	UT	TC	WR	FI	SE	GV
AT	6.0	3.0	11.9	7.2	2.6	6.7	10.0	16.4	23.5	12.5
QC	2.6	1.1	21.8	7.1	3.7	7.6	9.7	14.3	24.9	7.0
ON	1.9	2.0	21.8	6.4	3.2	6.4	9.7	18.2	23.2	7.0
PR	6.1	16.7	8.4	7.6	2.4	6.8	9.0	15.5	21.0	6.4
BC	6.4	2.7	14.3	6.7	2.3	8.1	9.7	19.9	23.2	6.6

Table A5.3
Region shares (percentage)

	1963	2001
AT	6.8	5.6
QC	24.4	21.6
ON	39.6	42.0
PR	18.5	18.7
BC	10.7	12.1
NE	5.9	5.9
MA	23.2	18.7
SO	14.1	20.0
GL	24.6	17.4
PL	5.4	4.1
MN	1.2	1.0
SW	9.9	13.0
FW	15.4	20.0

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Discussion

Tamin Bayoumi

Like most good papers, the study by Gosselin et al. comes from a very simple but powerful insight—with real GDP by sector of origin for US states and Canadian provinces (using a relatively consistent methodological approach), it is possible to create a data set describing activity across two dimensions—location and industry—for industrialized North America. The authors construct such a data set and use factor analysis to examine the relative contribution for Canada of idiosyncratic disturbances to those at the provincial/state level, the national level, and at the North American level. The latter is identified as a US shock on the assumption that Canada is a small open economy that does not affect, but is affected by, its southern neighbour.

Results and Policy Conclusions

This clear and well-written paper finds three main results:

- Common Canadian shocks are the most important contributors to the Canadian cycle. Hence, there appears to be a Canadian cycle that is relatively important and that is not dominated by idiosyncratic, provincial, or North American disturbances.
- These shocks have become more important over time compared to idiosyncratic shocks. There seems to be a trend for Canada to become more of a national economy over time.

- The importance of North American (identified as US) disturbances has also risen, particularly in those sectors most exposed to trade, including primary products. This finding corresponds to evidence of increasing ties with the United States after the passage of the Free Trade Agreement (FTA) and the North American Free Trade Agreement (NATFA). Indeed, given the strong evidence of closer ties with the United States over this period, it could be seen as being closer to a model validation check, since not finding this result would have led one to question the methodology.

Based on these results, the authors support three policy conclusions:

- Economic flexibility is important in an economy such as Canada. This is a statement I can wholeheartedly support.
- Canada has a strong business cycle and hence needs its own currency, and the case for a separate currency has been growing stronger over time. I find this assertion less persuasive, since there is no comparison with other regions (most obviously, with the euro area or the United States). Without comparison with other currency unions, I cannot see how these results allow the authors to make such an assertion.
- There is a role for countercyclical fiscal policy at the provincial level. I am extremely skeptical about this conclusion, for two reasons. Provinces are generally highly open to trade, meaning that a large proportion of any addition to aggregate demand does not flow into provincial activity. In addition, Ricardian effects diminish the effect of aggregate demand at a provincial level, whereas (to the extent that provincial cycles are offsetting in terms of the national deficit) this does not occur at the national level (Bayoumi and Masson 1998).

Analytic Approach

I have two main comments regarding the authors' analytic approach. First, they do not compare changes in Canadian behaviour over time with those for another country. Since the type of analysis of variance decomposition used here does not lend itself to formal statistical tests, the authors provide no formal statistics on the likelihood that the trends being identified are important. However, this limitation puts a premium on other forms of comparison to ensure that change in (say) the proportion of shocks attributed to the Canadian cycle does not reflect a change in the nature of the shocks hitting all economies. For example, large idiosyncratic shocks over the 1960–81 period could simply reflect the oil shocks of the 1970s. The most obvious way of checking that the trends identified in the Canadian economy over time do not reflect "global" trends is to compare these results with those of other countries. Given that the data set includes Canada and the

United States, it would seem sensible to compare the statistics found for Canada with the experience of the United States (as noted, a comparison with the euro area would also be helpful).[1]

Second, the authors do not identify industry-specific disturbances, which is surprising, since the basic data cover both location and industry of origin. Normally, if the panel has two dimensions, they can be added to the factor model. Including sectoral shocks (possibly at the cost of a slightly simpler estimation procedure) would help answer the question of whether the increase in Canadian and North American shocks largely reflects an increase in the importance of industry-specific shocks as barriers to trade have fallen and intra-industry trade has increased, or indeed whether it reflects increasingly national disturbances, as argued in the paper.

My suggestions for the analysis would be to (i) include industry-specific shocks, and (ii) compare the Canadian results with those from the United States (at the least) to account for "global" trends in the nature of the shocks over time.

Finally, the International Monetary Fund has been examining the nature of Canadian cycles from a more macroeconomic point of view, looking at which variables explain the evolution of Canadian regional domestic products. As can be seen in Table 1, the results suggest that oil-price hikes and exchange rate movements have differential effects across regions, supporting activity in Canada's Prairie provinces, while having a large impact on the industrial centre of the country. The US cycle is more important for the Prairies/central provinces than for the coastal regions, which have larger links with the rest of the world. These conclusions indicate that Canada, possibly to a somewhat greater extent than many other countries, remains a conglomeration of regional economies.

1. Using Hodrick-Prescott filters to detrend a series can interfere with the natural pattern of correlations, although I suspect that is not an important concern in this paper.

Table 1
Relative output growth across regions

	British Columbia	Prairie provinces	Central provinces	Atlantic provinces
Regional output growth[1]	0.15	0.07	0.18*	0.37**
	(0.17)	(0.18)	(0.09)	(0.14)
US GDP growth	0.63**	0.80**	0.79**	0.45**
	(0.17)	(0.14)	(0.11)	(0.13)
Real exchange rate change[1]	–0.13	–0.06	–0.16**	–0.11**
	(0.09)	(0.08)	(0.06)	(0.05)
Oil-price change[1]	0.00	0.04**	–0.02*	–0.02*
	(0.02)	(0.01)	(0.01)	(0.01)

Notes: Standard errors in parentheses; (*) significance at 10 per cent, (**) at 5 per cent.
Newey-West heteroscedasticity-consistent standard errors and covariance.
1. Lagged variables.

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Aspects of Canadian and US Business Cycles

*Graham Voss**

Introduction

The Canadian and US economies, by many measures and along many dimensions, are highly integrated and, possibly as a result of this integration, have highly correlated business cycles. This paper examines various aspects of the co-movement between the two economies. One objective is to document the relationship between the two economies at an aggregate level and to examine how the relationship might have changed over time. A further objective is to explore the relationship at a more disaggregate level by examining the interaction of the two economies on a sectoral basis.

A number of motives underlie these objectives. First, as a means for understanding the relationship between the two economies, it is useful to have a body of empirical regularities summarizing the co-movements of economic activity at different levels of aggregation. The second and more important motivation is to explore what linkages are important for explaining the behaviour of the two economies and for changes in this behaviour. In particular, the two economies have become increasingly integrated through international trade in goods and assets, including foreign direct investment, during the postwar period; it seems natural to ask whether this has led to increased synchronization of the two economies, as has been

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predicted by a number of recent cross-country studies of business cycle correlations.[1]

The behaviour of the two economies and whether the extent of synchronization has changed are of interest to those who wish to interpret or predict the behaviour of the Canadian economy. For instance, it might be of interest to know why the Canadian economy fared relatively well in recent years in contrast to the United States. The relationship between the two economies, however, is of broader interest than for this reason alone. The Canadian and US economies serve as a good example of how highly integrated but distinct national economies are likely to behave. In this sense, they serve as an alternative example to assessments of integration that compare regions within national economies, as explored by Clark and van Wincoop (2001) and Clark and Shin (2000). The analysis will visit these themes: a better understanding of the US-Canada relationship, and lessons more generally about the effects of integration on the synchronization of business cycles.

The analysis that follows has two features that merit comment. First, it is entirely non-structural in nature. In broad terms, the paper looks at a variety of measures of correlation between the two economies with an objective of providing a body of empirical regularities suggestive of the underlying linkages between the two economies. While the methods cannot provide definitive conclusions about the underlying shocks faced by the two economies and the methods by which they are transmitted, they do provide indirect evidence of important linkages and provide useful suggestions for future research. Furthermore, the methods lend themselves well to looking at a variety of issues, which might not be possible were more structured methods employed. Finally, the methods used here are very similar in spirit to the cross-country studies of business cycle correlations (such as Imbs (2004); Otto, Voss, and Willard (2003); Kose, Otrok, and Whiteman (2003); and Frankel and Rose (1998), among others) and the results from this literature inform the directions explored here. One way to interpret the analysis here is that it explores in detail the linkages between one of the cross-section data points, the US-Canada correlation, used in these studies. An advantage of doing so is that we can look systematically at instability in the relationship in considerable detail.

The second feature of the analysis is that it is somewhat disjointed, involving different data sets and empirical methods. As such, it is useful to

1. See, for example, Kose, Otrok, and Whiteman (2003) and Kose, Prasad, and Terrones (2003), which look specifically at the issue of stability of patterns of business cycle co-movements across countries.

provide a summary of what is done and why. The first task is to summarize the relationship between the two economies at an aggregate level. To do so, we examine dynamic correlations of four-quarter-ended growth rates of real output for the two economies over the past four decades. We consider the full sample, as well as two subsamples of equal size. The dynamic correlations give a slightly richer description of the business cycle interactions than is typically used in cross-section studies. The split sample is a simple means of examining any changes in the behaviour of the two economies.

We next examine the stability of the co-movement between the two economies more seriously, using Andrews (1993) parameter stability tests for unknown break points. This has the important advantage of providing estimates of the dates of structural break, as opposed to imposing them on the estimation and inference, and the results are useful for documenting changing business cycle correlations and how they might relate to increasing integration between the two economies. To foreshadow a key result, there is only weak evidence of a statistically significant change in the correlation between the growth rates of the two economies; this despite the increased integration of the two economies over the past four decades.

The results from this section also relate to recent studies that examine changes in mean and variation of growth rates in Canada (Curtis 2001; Debs 2001) and the United States (McConnell and Perez-Quiros 2000). Both McConnell and Perez-Quiros and Debs use similar methods to those here to identify structural breaks, and it will be useful to compare the results here to these studies.

The next step is to examine what might underlie the shifts in mean, standard deviation, and (possibly) correlation, by performing similar stability tests on the expenditure components of total output. This is similar to McConnell and Perez-Quiros (2000) and Debs (2001) and provides useful information about the role of domestic and external influences on the Canadian economy and its synchronization with the US economy.

The final part of the analysis again considers a disaggregation of output to better identify the linkages between the two economies. Now, however, the focus is on industry sectors. Data limitations prevent serious stability analysis, so the focus changes to an investigation of which sectoral linkages are important and what might explain this importance. Much of the analysis is similar to studies of the effects of borders on business cycle synchronization, e.g., Clark and van Wincoop (2001). These studies typically identify a significant border effect—countries are likely to be less synchronized than regions within national borders. This is interpreted as evidence of the effects of increased integration, viewed roughly as

equivalent to removing national borders. Interestingly, our sector analysis identifies no border effect—Canada and the United States appear to operate, in terms of business cycle synchronization, at a sectoral level, as one large economic region. While this is interesting in its own right, we also consider how this contributes to the literature on integration and business cycle synchronization.

1 Canada-US Synchronization

1.1 Data

Throughout this section, we use quarterly, seasonally adjusted real GDP measures as a summary measure of economic activity. The sample used is 1961Q1–2004Q1. Details of the data and sources are provided in Appendix 1. To measure the cyclical behaviour of the two economies, we use four-quarter-ended growth rates. While this is not strictly a measure of the business cycle, it does have advantages over alternatives, such as the Hodrick and Prescott (1997) filter or Baxter and King's (1999) band-pass filter. Business cycle filters such as these involve the loss of data at both ends of the sample (see the discussion in Baxter and King). In the current context, this means that the information available from the past few years, where Canada and the United States have had somewhat different experiences, would not be available. In addition, growth rates are perhaps more readily interpretable than the filtered data. Finally, the use of growth rates is also consistent with recent related studies, notably Clark and van Wincoop (2001), Curtis (2001), Debs (2001), and McConnell and Perez-Quiros (2000), which makes comparison easier.[2]

1.2 Simple empirical summaries

Figure 1 presents four-quarter-ended growth of the two output series; evidently, the two series are highly correlated. Table 1 reports the means and standard deviations of Canadian and US GDP, as well as correlations between Canadian GDP, $x(t)$, and leads and lags of US GDP, $y(t \pm j)$, $j = 1 \ldots 4$. Statistics in all cases are reported for samples ranging over 1963Q1–2003Q1, which takes account of the growth-rate calculations and the leads and lags used in the construction of the dynamic correlations reported. In addition to the full-sample estimates, the tables also report estimates for two subsamples, 1963Q1–1979Q4 and 1980Q1–2003Q1. The

2. Many of the results discussed in what follows are robust to using alternative filters. A further alternative is to consider quarterly growth rates; the possible disadvantage is the additional associated noise in quarter-on-quarter growth series.

Figure 1
Canadian and US GDP

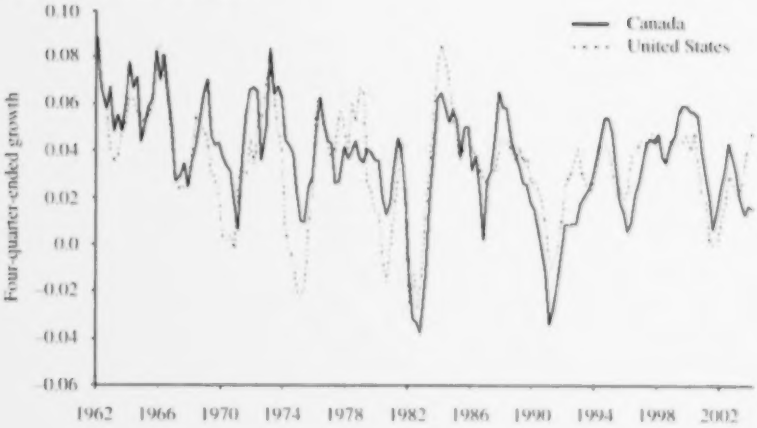

Table 1
Canadian and US GDP moments
Four-quarter-ended growth rates

	1962Q1–1979Q4		1980Q1–2004Q1		1962Q1–2004Q1	
Canadian GDP, $x(t)$						
μ_x	0.0466	(0.0034)	0.0285	(0.0048)	0.0361	(0.0035)
σ_x	0.0175	(0.0016)	0.0241	(0.0032)	0.0233	(0.0027)
US GDP, $y(t)$						
μ_y	0.0389	(0.0055)	0.0296	(0.0040)	0.0335	(0.0034)
σ_y	0.0246	(0.0034)	0.0208	(0.0029)	0.0230	(0.0021)
Correlations						
$\rho(x_t, y_{t-4})$	0.1666	(0.1411)	0.2554	(0.1256)	0.2831	(0.0789)
$\rho(x_t, y_{t-3})$	0.4100	(0.1281)	0.4197	(0.1264)	0.4576	(0.0771)
$\rho(x_t, y_{t-2})$	0.6227	(0.1108)	0.6109	(0.1099)	0.6278	(0.0700)
$\rho(x_t, y_{t-1})$	0.7286	(0.0997)	0.7693	(0.0786)	0.7445	(0.0580)
$\rho(x_t, y_t)$	0.6933	(0.0917)	0.7948	(0.0540)	0.7421	(0.0530)
$\rho(x_t, y_{t+1})$	0.5045	(0.0978)	0.6567	(0.0699)	0.5999	(0.0689)
$\rho(x_t, y_{t+2})$	0.3108	(0.1103)	0.4263	(0.0993)	0.4004	(0.0911)
$\rho(x_t, y_{t+3})$	0.1130	(0.1323)	0.1621	(0.1285)	0.1776	(0.1121)
$\rho(x_t, y_{t+4})$	-0.0653	(0.1558)	-0.0673	(0.1543)	-0.0177	(0.1308)

Notes: Series are four-quarter-ended growth rates of seasonally adjusted GDP; see Appendix 1 for details and data sources. Moments are estimated using generalized method of moments (GMM) with numbers in parentheses Newey and West (1987) standard errors with a lag truncation parameter of four.

focus on a break at the midpoint of the series is arbitrary; tests for parameter stability with unknown break points are discussed below. The estimates of the means, standard deviations, and dynamic correlations and associated standard errors are calculated using GMM with Newey and West (1987) robust standard errors (the lag truncation parameter is set to four).[3]

For the full sample, Canadian and US GDP have, on average, grown at similar rates, 3 to 3.5 per cent, and with similar volatility in these growth rates (standard deviations are just over 2 per cent). The contemporaneous correlation between the two economies is, as is well known, quite strong, 0.74. Relative to most other relationships between industrialized countries, this is high. For example, Otto, Voss, and Willard (2003) consider the bilateral relationships between 22 Organisation for Economic Co-operation and Development (OECD) economies and report a mean correlation of 0.32 for the 1972–2000 period. The dynamic correlations suggest a slightly stronger correlation between lags of US GDP and current Canadian GDP than the reverse, providing weak evidence that the US economy leads the Canadian economy. This is consistent with the idea that the US economy is an important source of external shocks for the Canadian economy, at least in part because of the strong trading relationships between the two economies. Note, however, that the differences in correlations are not particularly large and, given the associated standard errors, it is not possible to make a strong argument in this regard.

Interestingly, this suggestion that the US economy leads the Canadian economy is not consistent with the evidence from more formal business cycle dating schemes, such as provided by the Economic Cycle Research Institute (ECRI), which uses the same dating methodology for a variety of countries as that used by the National Bureau of Economic Research (NBER) for the United States.[4] Since a number of other interesting points of comparison between the US and Canadian economies arise when considered from the perspective of these business cycle dating methods, we present a summary of the Canadian and US ECRI dates in Figure 2. An attractive feature of the dating schemes is that they allow for a comparison over a longer sample period, 1948–2004.

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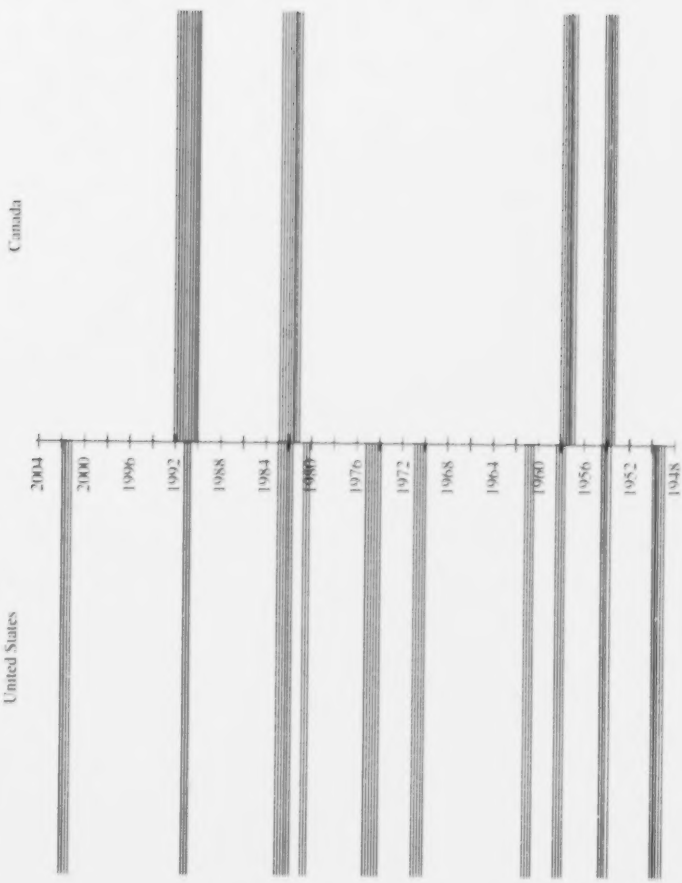
3. Newey and West standard errors are appropriate here, since the moment conditions are certainly serially correlated. The inverse of the Newey and West (1987) variance-covariance matrix is used as the weighting matrix for estimation. Five iterations are used in the estimation process.

4. The dates for the United States are taken directly from the NBER. The dates for Canada, the United States, and other countries are available at: <http://www.businesscycle.com/data.php#intldates>.

Figure 2
Canadian and US business cycle
ECRI business cycle peak and trough dates



The first striking feature is the significantly greater number of recessions (quarters between peak and trough) experienced by the United States relative to that of Canada—ten versus four. From this perspective, a recession in the United States is not sufficient cause for a recession in Canada, a conclusion not likely shared by many commentators on the Canadian economy. Nor is this conclusion an artifact of a particular time period: idiosyncratic recessions in the United States appear throughout the sample, including the most recent downturn in the United States in 2001.[5] The second striking feature concerns the timing of the contractions. For all four contractionary periods experienced by Canada, there is a roughly coincident contraction in the United States. And in each case, the Canadian economy led the way. This appears to be somewhat at odds with the notion that Canada is highly dependent upon the US economy and that downturns in the United States lead, through trade and possibly other channels, to downturns in Canada. Otherwise stated, there is no compelling evidence in Figure 2 that the United States is an important source of shocks to the Canadian economy.

Of course, what is missing in a simple comparison of business cycle dates is information concerning the linkages between the economies at all points in the sample, not just the start of periods of contraction. For example, during periods of expansion in the United States, variation in US output is almost certainly going to have some influence on Canadian output. This is why the focus here is the time-series properties of cyclical macroeconomic series. Nonetheless, Figure 2 is instructive in that at a coarse level, the US and Canadian economies often behave quite distinctly.

The strong relationship between the two economies over the past forty-odd years, as identified in Table 1, is generally well known. What is less well documented is how this relationship has evolved. Table 1 provides a comparison of estimates from arbitrary subsamples, 1963Q1–1979Q4 and 1980Q1–2003Q1 (roughly the midpoint of the sample). For these subsamples, there is a fall in growth rates between the early and later period, with the greatest dip for Canadian GDP (from nearly 4.5 per cent to less than 3 per cent). In addition, there are changes in volatility: the United States experiences a decline in the standard deviation of growth rates, while Canada experiences a rise. These results are consistent with earlier studies and will be discussed in further detail.

5. With respect to the number of peak to trough or contractionary periods, the United States appears to be unusually blessed relative to other countries, which typically have contractionary periods similar in number to Canada.

For the correlation statistics, while there are some changes suggested over the two subsamples, they are not, in most instances, particularly large relative to the reported standard errors. One result merits comment, however. In the early subsample, the strongest correlations occur between Canadian GDP growth and US GDP growth in the previous quarter, again suggesting that the US economy leads the Canadian economy. In the second subsample, this is no longer the case; the strongest correlation occurs between the two contemporaneous growth rates. We might argue that this reflects the growing integration of the two economies, but because the relative magnitudes are not particularly large, it is again difficult to argue this point strongly.

1.3 Tests for parameter stability—aggregate GDP

We next examine the instability of the moments of the output-growth series more formally, using parameter stability tests for GMM estimators proposed by Andrews (1993). These tests have the advantage of allowing for unknown break points and for providing an estimate of the timing of any structural break in the parameter estimate. Results for these tests (specifically the sup$W$ statistics, which are the supremum of a series of standard Wald tests for equivalence of parameter vectors across a sequence of subsamples) are reported in Table 2, as are the associated break dates where relevant. Also reported are subsample estimates based on the estimated break date.

The main objective is to examine the stability of the correlation coefficient for the two growth rates. This is, however, not a straightforward task. We know from other studies, such as Debs (2001) and McConnell and Perez-Quiros (2000), as well as from the results in Table 1, that the means and standard deviations of the two series are not likely to be stable. Any test of parameter instability for the moments of these series is going to have to allow for this source of instability in addition to possible instability in the correlation coefficient. One simple means of doing so is to set up the estimation of the five-moment parameters (means, standard deviations, and correlation coefficient) simultaneously and test for stability across the entire vector of estimated parameters. This is the first approach taken, but it has two drawbacks. First, it considers only a single common date for structural change across the entire parameter vector. Second, it does not provide direct information about the correlation coefficient itself, only about the stability of the entire parameter vector. An alternative is to proceed in stages—first, identify any structural change in the means and standard deviations, then use this information to standardize the data so that the means and standard deviations are constant across the full sample. It is then possible to test for parameter stability of the correlation coefficient alone.

Table 2
Canadian and US GDP moments—stability tests
Four-quarter-ended growth rates

Canadian GDP, $x(t)$ US GDP, $y(t)$ Stability tests	p	supW	CVs [10%, 5%]	Date	Sub-sample First	Sub-sample Second
All moments						
$\mu_x, \mu_y, \sigma_x, \sigma_y, \rho_{xy}$	5	47.2797	[15.17, 17.25]	1985Q1	*see below*	
First subsample	[0.0413, 0.0357, 0.0237, 0.0281, 0.7665]					
Second subsample	[0.0297, 0.0308, 0.0212, 0.0140, 0.7714]					
Individual moments						
μ_x	1	18.4790	[5.59, 7.05]	1974Q2	0.0532	0.0294
μ_y	1	5.1732		—	*0.0335*	
$\sigma_x[\hat{\mu}_{x1}, \hat{\mu}_{x2}]$	1	5.5230		1981Q4	0.0163	0.0235
$\sigma_y[\hat{\mu}_y]$	1	35.9995		1985Q1	0.0288	0.0131
$\rho_{xy}[\hat{\mu}_{xj}, \hat{\mu}_{yj}, \hat{\sigma}_{xj}, i = x, y; j = 1, 2]$	1	4.6593		1980Q1	0.6410	0.7858

Notes: The sample is 1962Q1–2004Q1. The series are four-quarter-ended growth rates of seasonally adjusted GDP; see Appendix 1 for details and data sources. Moments are estimated using GMM with numbers in parentheses Newey and West (1987) standard errors with a lag truncation parameter of four.
Stability tests are the supW tests from rolling samples, as described in Andrews (1993). The sample break points used run from $0.25 \times T$ to $0.75 \times T$, T the full sample size. p identifies the number of parameters, and critical values (CVs) are from Table 1 in Andrews (1993). Where a break is evident at standard significance levels, the date is reported.
$m[\hat{n}]$ indicates that the stability tests statistic for parameter m is constructed conditional on estimated sample or subsample estimates of $\hat{n}$. Sample or subsample estimates are indicated with subscripts 1 and 2, with break date as indicated in the table for the relevant parameter. For further details, see text. When estimation is conditioned on these initial estimates, the reported critical values serve only as a guide.

Table 2 reports the results of the parameter stability tests for Canadian and US GDP growth rates. The moments are estimated using GMM, as is done in Table 1. In contrast to Table 1, however, we consider only the contemporaneous correlations. A full assessment of the dynamic correlations is an extensive undertaking and, for brevity and clarity, we choose to focus on a smaller set of moments.

The first test considers parameter instability across all five moments: the means, standard deviations, and the correlation coefficient of Canadian and US GDP growth rates. For these five parameters, the null hypothesis of parameter stability is strongly rejected with an estimated break date of 1985Q1. (The critical values are reported in the table and are taken from Andrews (1993).) The reported subsample estimates indicate what underlies this result. Most noticeable are a substantial fall in mean growth rates for

Canada and a substantial fall in the standard deviation of US growth rates. At this break point, there is virtually no change in the correlation between the two growth rates.

As discussed, this gives only a partial picture of the underlying parameter instability. The remaining tests in the table attempt to isolate different sources of instability and allow for different possible break dates. To do so, each moment parameter is considered in turn.

We begin with the mean growth rates for Canada and the United States. For Canada, there is strong evidence of a structural break occurring in 1974Q2. For the United States, we cannot reject, at the 10 per cent level, the hypothesis that the mean growth rate is stable over the sample. This latter result is consistent with McConnell and Perez-Quiros (2000). The result for Canada is also consistent with previous work of Debs (2001).[6,7] The subsample estimates reported in Table 2 indicate the nature of the structural break—Canada experienced a fall in mean growth from roughly 5 per cent prior to the early 1970s to an average of roughly 3 per cent afterwards.

We next consider the behaviour of the standard deviations of the two series. Because of the estimated shift in mean for the Canadian series, the Canadian growth series is demeaned using the subsample estimates reported in Table 2. For the US growth-rate series, we assume that the mean is constant and demean using the full sample estimate.

The two series may now be reasonably assumed to have constant means (equal to zero). The next stage is to estimate the mean and standard deviation for each series and to test for structural change of the standard deviation parameter (treating the mean estimate as constant across the entire sample). For both the United States and Canada, we find evidence of parameter instability, though the evidence is much stronger for the United States than for Canada.[8] For the United States, the standard deviation in the

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6. The focus of Debs (2001) is on the residual variance of an AR process for quarterly growth rates of Canadian GDP. In doing so, Debs also considers the stability of the conditional mean parameters of the AR process, which relates loosely to the mean growth rates here, finding weak evidence of a structural break in the early 1970s consistent with results here.

7. The test statistic for the US mean growth rate is not far off the 10 per cent significance level, and one might wish to allow for a break in mean. We do not do so here, in part because a line has to be drawn somewhere and in part because of the evidence in McConnell and Perez-Quiros, which also suggests that the mean growth rate has been stable. For completeness, the early and late subsample estimates associated with the reported sup$W$ statistic are 0.0452 and 0.0299; the associated break date is 1973Q4.

8. In fact, the test statistic is smaller than the 10 per cent critical value, but only just; we interpret this as a rejection of parameter instability.

latter sample is roughly half of what it is in the early sample, from 0.029 to 0.13. For Canada, the change is not so large and occurs in the opposite direction: the standard deviation of GDP growth has risen from 0.16 to 0.24. The timing of the changes is similar; for Canada, it occurs around 1981Q4, while for the United States it occurs a bit later, around 1985Q1. The US result is consistent with McConnell and Perez-Quiros (2000), which examines this shift in variation in some detail. The result for Canada differs somewhat from that reported in Debs (2001), which identifies a change in volatility of GDP growth in the early 1990s, though this is likely a reflection of the differing details in approach. Debs is concerned primarily with the residual variation of an AR model of GDP growth, in effect, examining the stability of variation in shocks to Canadian GDP growth. In contrast, the focus here is the standard deviation of GDP growth itself as this affects the correlation coefficients of interest.

Finally, we can consider the correlation between the two series in a similar fashion to that of the standard deviations. Starting with the demeaned US and Canada series, each is standardized using the estimated subsample standard deviations so that for the full sample we have series with means zero and standard deviations of one. The five-moment parameters (means, standard deviations, and correlation) are then estimated, and the stability of only the correlation coefficient is tested (the other parameters are assumed to be constant). The associated test statistic is reported in the final column of Table 2.

The test statistic is somewhat less than the 10 per cent critical value, so strictly speaking, we cannot reject, at the 10 per cent level, the hypothesis that the correlation coefficient is stable. For completeness, however, the associated date and subsample estimates are reported. As expected, the latter sample, post-1980Q1, has a higher correlation coefficient, 0.79 compared to 0.64. We interpret this as providing some limited, weak evidence that the correlation coefficient between the two economies has risen in the past two decades, although the change is not substantial.[9]

In summary, we have strong evidence that Canadian mean growth has fallen, associated with a structural break occurring in the early 1970s. There is no such change in mean growth for the United States. There is further evidence that Canada has experienced an increase in the volatility of output growth dating from the early 1980s; in contrast, the United States has experienced a decline in output fluctuations dating from the early to mid-1980s. Finally,

9. One reason we do not interpret the significance levels literally is that the test statistics are conditioned on estimates of structural breaks in the means and standard deviations that the inference does not properly consider. The critical values serve only as a guide.

there is weak evidence of a small rise in the correlation between growth rates of the two economies dating from the early 1980s. In the following section, the sources underlying the changes in the Canadian parameter estimates, including the correlation coefficient with US growth rates, are considered further. To do so, we follow McConnell and Perez-Quiros (2000) by examining how different expenditure sectors have contributed to the changing nature of Canadian growth rates.

1.4 Tests for parameter stability—expenditure components

Table 3 reports a similar analysis to that of Table 2 for the expenditure components of GDP: consumption (C), investment (I), government spending (G), exports (X), and final domestic demand ($C + I + G - M$), where M is imports. (The exact definitions and sources are provided in Appendix 1.) The results for GDP (Y) are also reported (these are the same as in Table 2). As before, each series is first tested for a break in mean, then for a break in standard deviation, and finally for a break in correlation with US GDP. Where a break is identified in either mean or standard deviation, that information is used in standardizing the series for the subsequent parameter stability tests. For the expenditure components, the series are the growth contributions to GDP; that is, they are constructed as the four-quarter-ended growth rate for the sector weighted by the sector's share in GDP.

For the mean growth contributions, there is strong evidence of structural breaks occurring in the mid-1970s for consumption, government spending, and final domestic demand. The government spending contribution falls to about one third of its mean contribution in the 1960s and early 1970s; the mean consumption contribution falls by slightly less than half, as does that of final domestic demand. Although the estimated break dates vary somewhat across these expenditure components and total output, it is probably safest and most reasonable to interpret the dates as being roughly coincident. In contrast to consumption and government spending, the results show a stable contribution from investment and exports. Looking more closely at exports, there is a statistically significant break in the mean growth rate of exports around about 1973; growth falls from an average of 9 per cent to about 5 per cent. This appears to be offset, however, by an increasing share of exports in total GDP.[10]

It is not possible to determine from these results the cause of the slowdown in economic growth, but the results do provide useful information. First, as

10. The sup W statistic for mean export growth is 9.6408 with break date 1973Q3. The first sample mean growth rate is 0.0925, the second sample 0.0488.

Table 3
Expenditure decompositions
Four-quarter-ended growth-rate contributions

			Subsample		Estimates
	sup$W$ (p = 1)	CVs [10%, 5%]	Date	First	Second
Break in μ					
C	23.9768	[5.59, 7.05]	1977Q1	0.0287	0.0150
I	2.6639		—	*0.0068*	
G	44.8486		1976Q2	0.0126	0.0043
X	3.6016		—	*0.0152*	
$C + I + G - M$	23.0744		1976Q2	0.0519	0.0258
Y	18.4790		1974Q2	0.0532	0.0294
Break in σ					
C	16.7502		1992Q4	0.0101	0.0049
I	4.5012		—	*0.0110*	
G	10.6443		1972Q4	0.0059	0.0040
X	38.7843		1972Q3	0.0082	0.0185
$C + I + G - M$	5.8353		1993Q1	0.0212	0.0136
Y	5.5230		1981Q4	0.0163	0.0235
Break in ρ(z,y)					
C	19.2644		1992Q2	0.7473	0.4742
I	9.7577		1984Q4	0.2944	0.7013
G	5.7071		1981Q1	-0.3770	-0.0714
X	23.3641		1972Q3	-0.0174	0.6145
$C + I + G - M$	14.1945		1972Q2	0.7874	0.4133
Y	4.6593		1980Q1	0.6410	0.7858

Notes: The sample is 1962Q1–2004Q1. The series are four-quarter-ended growth rates of seasonally adjusted GDP; see Appendix 1 for details and data sources. Moments are estimated using GMM with numbers in parentheses Newey and West (1987) standard errors with a lag truncation parameter of four.

Stability tests are the sup$W$ tests from rolling samples, as described in Andrews (1993). The sample break points used run from $0.25 \times T$ to $0.75 \times T$, T the full sample size. p identifies the number of parameters, and critical values (CVs) are from Table 1 in Andrews (1993). Where a break is evident at standard significance levels, the date is reported. Where no break is evident, the full sample moment is reported. For the correlation coefficient, the date of the associated statistic is always reported.

For the mean and standard deviation, if a break is assumed evident (date reported), then the subsequent stability tests use the estimated break dates to adjust the moments; see Table 2 and text for further explanation.

noted, despite the fall in export growth, its contribution has remained stable (at approximately 0.015) and does not appear to be the source of the decline. The decline in consumption growth (and as its major component, final domestic demand) is difficult to explain, since there are many possible causes, not the least of which is the decline in income growth, which we wish to explain. The declining contribution from government spending can be more easily interpreted as a possible cause of the declining output growth

rate. This is similar to the interpretation provided by Curtis (2001). He argues that the decline in the GDP growth rate, which he informally dates around 1980, is coincident with a change in emphasis of fiscal policy. The results in Table 3 tend to support this argument, although the effects occur earlier than suggested. This, however, provides no information about whether the decline in government spending growth was appropriate or not, merely that there may have been a link between the two.[11]

For the standard deviation of the growth contributions, recall first that the standard deviation of GDP growth increases with a (weakly) statistically significant break occurring in 1981Q4. When we look at the expenditure component contributions individually, no clear story emerges to explain the source of this break. There is evidence of a break in variation for consumption, government spending, exports, and final demand; however, these do not occur at a similar time. Consumption and final demand both have a break in standard deviation in the early 1990s and, in both instances, the standard deviation falls. The growth contribution of government spending also falls but does so much earlier in the early 1970s. These sectors—in particular, consumption and government spending—are clearly not the source of the rising variation in GDP growth. The culprit appears to be the export growth contribution, which saw a dramatic increase in variation in the early 1970s.[12] A natural explanation for this result, though it is conjecture, is that the increased variation of the export contribution roughly coincides with the move to a floating exchange rate in the early 1970s. Greater variation in exchange rates may have given rise to greater variation in export contribution. In addition, the increased variation may also be related to increased variation in energy commodity prices occurring at this time. A better understanding of the behaviour of Canada's export sector and its contributions to GDP would seem to be important for an understanding of the increased volatility of Canadian GDP growth in the past thirty years.

Curtis (2001) also considers possible explanations for the rising standard deviation of output and argues that the refocusing of macroeconomic policy away from aggregate demand stabilization to medium-term objectives

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11. The discussion implicitly treats government spending as largely exogenous, but this is clearly a simplification. It is perfectly possible that the fall in government spending arose in part through lower aggregate output/income growth. Sorting out cause and effect requires a structural model. The contribution of our approach is to identify the timing of the event and the role government spending may have in understanding the decline in mean growth rates.

12. It is not possible to be definitive, because the variation of output depends not only upon the variance of its components' growth contribution but on the covariation among the different expenditure components as well.

(budget balance in the case of fiscal policy and money or inflation targeting in the case of monetary policy) is partly responsible. This argument, however, is not supported by the results here; were this argument correct, we would almost certainly observe a similar rise in standard deviation in consumption and final demand, with expenditure components likely to be sensitive to monetary and fiscal stabilization policy. In fact, the evidence points to these falling after the early 1990s.[13]

Conditional on these estimates, we now consider the changing nature of correlations between expenditure components (growth contributions) and US GDP growth. In Table 2, we find an increase in correlation for Canada and US GDP that is, at best, weakly significant; of interest here is to see what sectors, if any, might underlie this small increase. It is also interesting to consider the behaviour of these sectors in their own right, since they shed light on the linkages between the two economies.

All expenditure components have evidence of a statistically significant (10 per cent level) change in correlation with the United States. The direction and timing of the changes, however, are not consistent across sectors. Three sectors see an increase in correlation with US GDP: investment, government spending, and exports. The largest absolute change is with the export contribution: for the period 1962–1972Q3, the correlation with US GDP is roughly zero; for the period 1972Q4–2004Q1, the correlation is 0.61. As we might suspect, the growing trade linkages and increasing trade volume with the United States are important factors in the business cycle synchronization of the US and Canadian economies. Interestingly, this happens well before events such as NAFTA and other increases in integration. The correlation between investment and US GDP also rises significantly, though the estimated break date occurs later, 1984Q4. While there may be many possible causes, three potential explanations (all possibly related) are the following. First, the increasing financial integration of the Canadian and US economies may link investment growth in this country much more closely to what is happening in the United States. Second, strong growth in the United States may encourage investment in Canada in the tradables sector. Finally, the responsibility may lie with foreign direct investment in Canada, which has become easier in the past two decades.[14]

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13. One possibility is that we are missing the breaks in standard deviation in these series, coincident with that of aggregate output as they are dominated by the break in the early 1990s. In other words, there may be more than the single break for which we test. As this is not the principal focus of this paper, we leave this for later work.

14. The other sector that has seen an increase in correlation with US GDP is the contribution from government spending. What underlies this increase, however, is not clear.

Turning to consumption and, the closely related measure, domestic final demand, we have the opposite result: a significant fall in correlation with US GDP with an estimated break date in the early 1990s. The cause of this change is not clear, though the timing suggests that the longer and lengthy recession experienced in Canada may be a contributing factor.

Rather than further speculate on the underlying sources, it is more useful to consider the broader picture. The results in Table 3 suggest that expenditure components, such as investment and exports that have possibly strong external linkages, have increased their degree of correlation with US growth. This is very much consistent with arguments elsewhere that the degree of synchronization between economies has increased as barriers to international trade and finance have fallen in recent decades. Offsetting this, however, is a domestic sector captured by consumption and domestic final demand that has weakened its relationship with external influences. The net effect of this is a relatively stable correlation (or one that shows a small increase) between US and Canadian GDP growth. Given that consumption is such a large component of GDP, to better understand the relationship between Canada and the United States requires a better understanding of consumption behaviour in Canada.

The results here can be usefully related to studies that ask whether greater integration is likely to lead to greater synchronization of business cycles. This theme arises in studies such as Frankel and Rose (1998), which is concerned with optimum currency area criteria: whether countries that become more closely integrated through trade and/or financial linkages are more likely to have synchronized business cycles.[15] More generally, studies such as Kose, Prasad, and Terrones (2003) ask whether globalization, broadly defined, will affect business cycle synchronization. Theoretically, the conclusions for greater integration or globalization are ambiguous (see Kose, Otrok, and Whiteman (2003) or Imbs (2004) for a summary); empirically, however, there appears to be a consensus that stronger trade and financial linkages contribute to greater synchronization, at least in a cross-section of countries for a particular sample.

Studies that specifically look at whether synchronization has increased over time with the greater integration of trade and financial linkages, that is, globalization, are less clear. For example, Kose, Otrok, and Whiteman (2003) specifically consider changing patterns of synchronization for a broad set of countries and do not find evidence of increasing

15. Many studies of business cycle synchronization use the optimum currency area as a motivation. This is also explored using regional data; see, among others, Clark and Shin (2000).

synchronization over recent periods of greater integration. The results here cast light on possible reasons. What we observe is that trade integration does contribute to growing synchronization; however, against this is a weakening of the synchronization of Canadian consumption with the US economy. One might argue that this latter condition is in line with growing financial integration if we view the US economy as the major source of disturbance for the Canadian economy. This is only suggestive but does point to the possibility that the lack of evidence of globalization reported in Kose, Otrok, and Whiteman may reflect the competing effects integration has on economies and business cycle synchronization.

2 Canada-US Correlations—Industry Sector Data

This section examines the set of simple contemporaneous correlations between nine industry sectors located in Canada and the United States. It summarizes the relationships between industry components of the Canadian and US economies, including evidence on the role of common sector and national shocks, as well as on the relationships between tradables and non-tradables sectors. An examination of sector relationships within and across borders is also a natural extension of recent studies that emphasize the interaction among sectors as part of the propagation of business cycles within an economy. For Canada, see Barillas and Schleicher (2003).

The importance of industry sectors for understanding international business cycles has also been emphasized in previous studies. One issue is the degree of integration between countries and the relative importance of sector and national/regional shocks. Clark and Shin (2000) argue, for example, that increased integration between regions or countries raises the relative importance of sector-specific shocks. Since Canada and the United States are highly integrated, we anticipate that sector- or industry-specific shocks are likely to be important; our analysis provides some means of gauging just how important they are. A further issue relates to production specialization as an explanation for business cycle synchronization. Imbs (2004) argues that countries with similar patterns of production are likely to be highly correlated, through common shocks or common response to shocks. The analysis here provides information in this regard for Canada and the United States.

2.1 Data and the empirical model

The data used are annual gross value-added measures by sector from the OECD STAN Database for the period 1978–2001. For reasons discussed

previously, we use annual growth rates as a simple measure of cyclical behaviour in each sector.[16] There are nine sectors at a coarse level of aggregation; they are: agriculture, hunting, forestry, and fishing (AFF); mining and quarrying (MQ); total manufacturing (MAN); electricity, gas, and water supply (EGW); construction (CON); wholesale and retail trade, restaurants, and hotels (WRT); transport and storage and communication (TSC); finance, insurance, real estate, and business services (FIR); and community social and personal services (CS). The nine sectors across two countries give 18 time series and 153 correlation pairs.

Table 4 provides a simple summary of the set of correlation pairs: mean, range, and extreme correlation pairs. This is done for the full sample and for two subsamples that roughly split the sample in half. The means and ranges are fairly similar across the different samples, suggesting that the distribution of the correlation pairs is reasonably stable. Perhaps surprisingly, the maximum correlations in all samples are a cross-border correlation, while the minimum correlations are within Canada for two of the three samples. A further notable result is that two of Canada's export sectors, mining and agriculture, are so strongly negatively correlated. Investigating these sorts of issues is the purpose of the following more systematic examination of the patterns of correlations.

2.2 Border effect

Table 5 presents a simple breakdown of the correlation pairs into two groupings: within country and across country. The table reports the mean for each group and the difference that, following Clark and van Wincoop (2001), is termed the border effect. The border effect identifies the extent to which correlations within a country's borders exceed those across borders. Results for the full sample are reported, as are results for the two subsamples. The number of time-series observations available for the subsamples is quite small, which qualifies any conclusions.[17] For both the full sample and the subsamples, there is no evidence of a border effect: correlations across sectors within either the United States or Canada are, on average, the same as those correlations between sectors across the US-Canada border.

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16. The output series are real volume index measures. The advantage of the OECD STAN Database is that it provides a consistent set of comparable sector data for the two economies.

17. The reported standard errors are based on White's (1980) heteroscedasticity robust covariance matrix estimator; we use the weighting matrix HC3 as defined in Davidson and MacKinnon (1993, 552). Estimation issues are discussed further below.

Table 4
Sector correlations—summary statistics

	1978–2001	1978–89	1990–2001
Mean	0.1957	0.1965	0.1706
Standard deviation	0.2774	0.3696	0.3714
Minimum	−0.5340	−0.7366	−0.7857
Sector pair	MQ(CA):AFF(CA)	MQ(CA):AFF(CA)	CS(US):MQ(CA)
Maximum	0.8753	0.8995	0.8743
Sector pair	MAN(US):MAN(CA)	MAN(US):MAN(CA)	CON(US):WRT(CA)

Notes: The data consist of bilateral correlations of annual growth rates of value-added volume measures of sector production available from the OECD STAN Database. The correlations are constructed for growth rates over the samples indicated. The sectors are: agriculture, hunting, forestry, and fishing (AFF); mining and quarrying (MQ); total manufacturing (MAN); electricity, gas, and water supply (EGW); construction (CON); wholesale and retail trade, restaurants, and hotels (WRT); transport and storage and communication (TSC); finance, insurance, real estate, and business services (FIR); and community social and personal services (CS). Two countries with nine sectors each provides 153 correlation pairs. CA refers to Canada; US refers to the United States.

Table 5
Sector correlations

Sample period	Within-country average	Cross-country average	Border dummy
Border effect			
1978–2001	0.1896	0.2011	−0.0115
	(0.0342)	(0.0301)	(0.0456)
1978–89	0.2043	0.1895	0.0148
	(0.0447)	(0.0408)	(0.0606)
1990–2001	0.1578	0.1820	−0.0242
	(0.0449)	(0.0411)	(0.0608)

Tradables sector	Constant	Within CA	Within US	Within common sector	Within tradables sector
Common sector and tradables sector effects, 1978–2001					
AFF, MQ, MAN, TSC	0.1734	−0.0344	0.0443	0.1528	0.0156
	(0.0474)	(0.0632)	(0.0529)	(0.1079)	(0.0490)
MAN	0.1375	−0.0344	0.0443	0.1720	0.2121
	(0.0310)	(0.0609)	(0.0497)	(0.0913)	(0.0581)
MAN	0.1400	—	—	0.1695	0.2121
	(0.0243)			(0.0891)	(0.0576)

	Constant	Common sector	MAN(CA): CA	MAN(CA): US	MAN(US): CA	MAN(US): US
Common sector and manufacturing effects, 1978–2001						
	0.1402	0.1460	0.1697	0.2970	0.1249	0.2535
	(0.0239)	(0.0800)	(0.1260)	(0.1042)	(0.1125)	(0.0965)

Notes: The data are as described in Table 4. Numbers in parentheses are White (1980) heteroscedasticity robust standard errors using weighting matrix HC3 as defined in Davidson and MacKinnon (1993, 552).

The lack of a border effect in industry correlations is evidence of the considerable integration between the two economies. It also suggests that nation-specific factors are not particularly important for the business cycles of the two economies. This sets Canada and the United States apart from the expected behaviour of most national economies; most country-industry-based studies tend to conclude that nation-specific shocks are more important than common industry-based shocks at an international level (see the discussion in Clark and Shin (2000)). Put somewhat differently, the lack of border effect means that Canada and the United States behave, as far as their business cycles are concerned, as two integrated regions within an aggregate economy.

This lack of a border effect is potentially very useful information for assessing the impact of integration for national economies. Canada and the United States are highly integrated along many dimensions. Bilateral trade, financial markets, and direct investment are all high relative to most countries. Moreover, the Canada-US exchange rate is relatively stable over short horizons. On other non-economic dimensions, such as language and legal institutions, the two countries are also very similar. Thus, the two countries seem to represent a good example of what countries can expect of this extent of integration, short of full political and economic union, in terms of synchronization; and may be a better example than afforded by regional analysis. Viewed from another perspective, the results here support the regional analysis, such as Clark and Shin (2000), which argues that on the basis of regional comparisons, greater integration of national economies is likely to lead to greater synchronization and a dominant role for sector-specific shocks.

2.3 Common shocks and tradables sectors

In the second part of Table 5, we further decompose the set of correlations, using a simple dummy-variable regression model to identify possible effects. The first set of dummy variables identify within-country effects on correlation levels. We separate sector correlations within Canada and within the United States. If country-specific shocks are important, such as national monetary and fiscal policies, country-specific productivity, or other types of supply shocks, then the effect on predicted correlation should be positive.[18] Note that the two country effects are a decomposition of the within-country measure used in the first part of the table; the decomposition allows for different effects within the United States and Canada.

18. At the coarse level of aggregation used here, it is also possible that the country-specific effect may pick up consistent differences in sectors across countries; that is, the sectors are insufficiently similar to identify a common sector shock.

The second set of dummy variables, in this case, a single-dummy variable, identifies the set of correlations within a sector—by definition, across countries. There are nine such correlations. If sector-specific shocks are influential, we might expect these pairs to have higher correlations, all else being equal. In this limited sense, this effect captures the importance of common industry shocks, and by comparing the importance of this effect relative to the within-country effect, we obtain information about the relative importance of nation-specific shocks versus common industry shocks. The idea of a common industry shock is quite broad. It captures factors that might directly influence the behaviour of a particular industry sector across countries, for instance, a common supply shock. It also captures factors that influence a sector in one country that is then transmitted to the same sector in the other country through trade and/or investment linkages. Manufacturing in the United States and Canada is a natural example of such possible linkages within an industry sector. The next set of dummy variables attempts to control for these possible linkages.

The third set of dummy variables identifies sectors that are traditionally viewed as tradables sectors. If trade is an important transmission mechanism, we might suspect correlations between these sectors to be higher than average, all else being equal. Two possible sets of sectors are considered as representing tradables sectors. The first consists of what are essentially commodity-producing sectors, AFF, MQ, and MAN, and one service sector, TSC. This is roughly consistent with exchange rate studies, such as Engel (1999) and De Gregorio, Giovannini, and Wolf (1994), that rely on separating production sectors into tradables and non-tradables. The remaining sectors, primarily different types of services, are treated as non-tradables. The correlations we wish to identify as within a tradables sector are those pairs that involve at least one of the tradables sectors and possibly both. As examples of the linkages we are considering, correlations within a tradables sector include: (i) Canadian MAN with Canadian AFF; (ii) Canadian MAN with US FIR; and (iii) Canadian MAN with US MAN. Note that this grouping will overlap with the common sector grouping discussed previously. We also consider a variation on this definition, restricting attention to manufacturing. In part, this reflects the fact that manufacturing receives a lot of attention in industry sector studies, so it is of some interest to determine whether it has different effects. It also reflects that fact that the manufacturing sector is heavily integrated and traded between the two economies, and in each country, the manufacturing sector is a significant part of the aggregate economy.

With these sets of dummy variables defined as D_1, D_2, D_3, we have the following simple statistical model. Let $i, j = 1 \ldots 9$ denote sectors and $m, n = 1, 2$ denote countries. The linear regression model is:

$$\rho_{im,\,jn} = \beta_0 + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \varepsilon_{im,\,jn},$$

where $\rho_{im,\,jn} = corr(x_{im}, x_{jn}), i, j = 1 \ldots 9, m, n = 1, 2, i \neq j$, if $m = n$.

Though simple, care must be taken in estimating this model. First, as noted by a number of authors, the errors in the regression model are not going to be homoscedastic, since the correlation pairs are likely to be interrelated; in previous studies using such equations, such as Otto, Voss, and Willard (2003) and Frankel and Rose (1998), this is corrected for using White (1980) heteroscedasticity robust standard errors, and this is what we do here. In contrast, Clark and van Wincoop (2001) argue for a more sophisticated method for estimating the covariance matrix that takes explicit account of the sampling error in constructing the bilateral correlations. We leave this for future work.[19]

There is a further potential problem with the statistical model above that is usually overlooked. The dependent variable is constrained to be between −1 and 1, which means that the above cannot be treated as a simple linear regression model. It is straightforward to correct for this using a simple transformation of the model; details are in Appendix 1. We present results using both estimation methods (Appendix 1 describes the estimation of the transformed model with results in Table A1.1); the former because they are more easily interpreted, the latter as a check that the simple linear model is not providing grossly misleading results.

The first regression reported in Table 5 uses the broad definition of the tradables sector. The next two use the manufacturing sector definition. Consider first the within-country effects, either within Canada or within the United States. Consistent with the upper half of the table, there is no border effect for these two countries, even when looking on an individual country basis. This result is robust to the two tradables sector specifications. Consider next the common sector effect. In this case, the effect is positive and statistically significant; again, this result is consistent across both definitions of the tradables sector.

Finally, there does not appear to be a tradables sector effect when tradables are broadly defined. Given the strong results in the literature that identifies a significant positive role for bilateral trade for business cycle synchronization, this seems surprising. If instead we narrow the definition and focus on linkages involving the manufacturing sector, we find a very strong, positive, and statistically significant effect. If we appeal to the simple linear model, sectors involving the manufacturing sector are expected to have

19. Whether or not this is an important issue is not clear; Imbs (2004) suggests that using Clark and van Wincoop's methods does not substantially alter his results.

correlation coefficients 0.21 higher than average, all else being equal. The next specification in the table drops the insignificant within-country effects, leaving the following summary of the sector correlations (again, using the simple linear model): the common sector effect adds about 0.17, while the within-manufacturing (tradables) sector effect remains at 0.21.

The tradables sector effect treats correlations within countries (e.g., US manufacturing and construction) the same as correlations across countries (e.g., US manufacturing and Canadian manufacturing). To see if there is a border effect within this class of correlations, we decompose the within-manufacturing effect into four possible effects: (i) linkages between Canadian manufacturing and other Canadian industries; (ii) linkages between Canadian manufacturing and US industries; (iii) linkages between US manufacturing and Canadian industries; and (iv) linkages between US manufacturing and other US industries.

The common sector effect remains significant though slightly smaller in magnitude. The manufacturing effects vary somewhat, both in size and whether they are statistically significant or not. If we first consider the within-country effects, denoted MAN(CA):CA and MAN(US):US, we find a statistically insignificant effect for Canada (a coefficient of 0.17 with a two-sided p-value of 0.18) and a strongly significant effect for the United States (a coefficient of 0.25 with a two sided p-value of 0.01). The magnitude of the US effect is also substantially larger than that for Canada. This suggests that the linkages between US manufacturing and the remaining US industry sectors are much stronger than the similar relationships for Canada. A possible explanation is that Canada's manufacturing sector is more outward-looking than that of the United States and consequently less integrated with the other sectors of the national economy.

If we next consider the cross-border manufacturing effects, denoted MAN(CA):US and MAN(US):CA, we find further evidence of the dependence of Canadian manufactures on the US economy. The effect for MAN(CA):US is very strong and statistically significant (a coefficient of 0.30 with a two-sided p-value of 0.01). In contrast, the coefficient for MAN(US):CA is statistically insignificant and small in magnitude (0.12 with a two-sided p-value of 0.27). US activity appears to be important for Canadian manufacturing, while US manufacturing does not seem to have a significant effect on Canadian industries.

In summary, the tradables sector linkages, as measured by interactions of all sectors with manufactures, are important only for cross-border correlations if they involve Canadian manufactures. As this involves only nine correlation pairs, they are provided in Table 6 for the full sample and the two subsamples. Five of the nine sectors have very strong and remarkably stable

Table 6
Manufacturing and common sector correlations

	AFF	MQ	MAN	EG/W	CON	WRT	TSC	FIR	CS
US industry sectors									
1978–2001	0.17	0.13	0.88	0.34	0.81	0.64	0.46	0.74	0.05
1978–89	0.17	0.26	0.90	0.49	0.88	0.61	0.46	0.74	0.35
1990–2001	0.20	–0.10	0.86	0.18	0.76	0.68	0.52	0.77	–0.25
Industry sectors									
1978–2001	0.06	0.33	0.88	0.17	–0.04	0.51	0.56	0.16	0.37
1978–89	0.17	0.33	0.90	–0.04	–0.41	0.36	0.63	–0.05	–0.19
1990–2001	–0.18	0.47	0.86	0.40	0.53	0.73	0.61	0.59	0.54

Note: The data are as described in Table 4.

correlations with Canadian manufacturing. These are US manufacturing (MAN); construction (CON); wholesale and retail trade (WRT); transportation, storage, and communication (TSC); and financial services (FIR). Clearly, the integration of the Canadian manufacturing sector across these US industries is likely to explain an important part of the overall synchronization between the two economies.[20]

In contrast, the common sector effect is much less uniformly strong and stable; for comparison, these are reported in Table 6, as well. It is useful to consider these correlations somewhat further with the idea of assessing to what extent the correlation across particular sectors can be explained by interdependence between the sectors themselves (for example, Canadian and US manufacturing are possibly quite closely linked through trade and foreign direct investment); by shocks common to particular sectors; and by a similar response of sectors to common aggregate shocks. Although we are unable to provide a definitive answer to the relative importance of these possible explanations, we can make some inferences along these lines.

There are four sectors that have high, relatively stable correlations: mining (MQ), manufacturing (MAN), trade (WRT), and transportation (TSC). Of these, manufacturing is much the strongest correlation, while mining is the weakest. For mining, it seems reasonable to think that an important component of this is global commodity demand and supply shocks and/or a similar response of these sectors to common aggregate shocks. For the remaining sectors, however, such a simple assessment is not as compelling, since it seems likely that these sectors are linked across the border. We

20. These results are robust to controlling for the restricted nature of the dependent variable; see Table A1.1. The coefficient magnitudes in this case are not directly interpretable; however, the relative magnitudes and inference are all unchanged from the simpler linear models reported in Table 5.

return to this point below; before doing so, however, there are two points to consider. First, one sector that would seem naturally to fall into the category of having important common shocks (or common response to aggregate shocks) would be the financial sector. Here, however, we see no common pattern of behaviour. The second interesting feature is the quite strong correlations in the final part of the sample across all sectors. The bulk of this sample involves a steady expansion of the two economies. One way to interpret the results is that the expansion had comparable effects on each industry sector; that is, a particular sector responded in a similar fashion over the expansion in both Canada and the United States.

A simple means of exploring the relative importance of whether common shocks are important in particular sectors or whether there are substantial linkages between the two is to estimate simple bivariate VAR models for each sector, consisting of growth rates of the US and Canadian sectors, and to examine the correlation of the residuals.[21] Small correlations relative to the correlation of the sector growth rates suggest that interdependence between the two sectors is important, while larger correlations suggest that common shocks may be important.[22] Table 7 reports the simple correlation for the bivariate VAR residuals for each sector. It does so using both growth rates and log levels. (The results are also similar if a trend is included in the log level regressions.) The focus is on the four sectors with high raw correlations identified above. For manufacturing, the residual correlations are very high, comparable to the sector-output correlations for manufacturing. A similar conclusion holds for trade and transportation. For mining, we obtain the interesting result that the shocks are more highly correlated than the outputs of the US-Canada sectors. Overall, there is little evidence of much dynamic interdependence between these sectors, suggesting that what underlies the high correlations of these sectors are common shocks or similar responses to common aggregate shocks. Given the broad conclusions from Table 6, which tend to support the role of trade linkages (at least through manufacturing), this result is puzzling. A more thorough study of the transmission mechanisms between Canada-US industries might resolve these issues.

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21. This is similar to Canova and Dellas (1993), though they perform their analysis on GDP for a cross-section of countries. See also Canova and Marrinan (1998), which explicitly examines the role of trade interdependence versus common shocks.

22. This is an imperfect means of investigating the underlying relationships between sector growth rates, but has the advantage of not requiring identification restrictions. Imposing identification restrictions to perform a more standard VAR-type analysis, for example, a recursive causal ordering, would allow more concrete statements to be made. However, as there is no obvious compelling structural identification to impose on the estimation, it seems preferable to carefully interpret the reduced-form VAR models.

Table 7
Correlation of sector shocks

	Common sector VAR(p): residual correlation coefficients								
	AFF	MQ	MAN	EGW	CON	WRT	TSC	FIR	CS
Industry sectors									
Growth rates	-0.26	0.76	0.91	0.06	0.19	0.45	0.58	0.07	0.25
Log levels	0.09	0.75	0.91	0.06	0.12	0.53	0.31*	0.49	0.34

Notes: The data are as described in Table 4. Correlations are for the estimated residuals from a bivariate VAR of order p. The VAR order was chosen on the basis likelihood ratio tests and tests for serial correlation in the residuals. VAR orders used for the above range from 2 to 4. An * indicates evidence of serial correlation even with a maximum lag length of four.

2.4 Further discussion

Examining simple correlations as we have done here does not provide direct information on cause and effect. At best, we can establish simple empirical features of the relationship between the Canadian and US economies that suggest underlying linkages. In this section, we review and discuss the results and attempt to place them in context. At their simplest, the results provide a descriptive summary of the Canada-US sector relationships. These might be useful as a guide to further theoretical and empirical research, for example, as a means of assessing sector business cycle models, such as Ambler, Cardia, and Zimmermann (2002). Moreover, the results here complement other studies of Canadian business cycle features, such as Koustas (2003), Barillas and Schleicher (2003), and Beine and Coulombe (2002).

The main points from the results in this regard are as follows. First, there is no border effect; equivalently, there is no evidence of national shocks for Canada and the United States. This result appears to be stable (given the limited data), so that the growing integration of the US and Canadian economies has not altered this conclusion. This is in line with the aggregate economy results in the first part of the paper that find only weak evidence of increased correlation between the two economies in recent decades. Second, there is a common sector effect, although it is not large. This might be explained by industry-specific shocks or by industry-specific responses to common aggregate shocks. The effect, however, is not uniform and there is evidence of instability over time.

Third, correlations involving sectors broadly defined as tradables are not significantly higher than the average. This result is surprising, since Canada and the United States have strong trade linkages, and Canadian tradables are likely closely interdependent with US sectors. This may reflect problems with looking across a broad set of sectors that have differing degrees of

dependence upon trade generally and trade specifically with the United States. A narrower definition of tradables that includes only the manufacturing sector does provide evidence of higher than average correlations. This is especially true for Canadian manufactures with the US economy and, in particular, Canadian manufactures are highly synchronized with US manufacturing, construction, wholesale and retail trade, and the financial industries. Moreover, this synchronization appears to be quite stable.

The next direction is to consider what information these results provide in regard to the synchronization or correlation of the two economies as a whole. The correlation of aggregate output growth rates will depend upon the underlying sector-growth correlations scaled by the share parameters for the sectors and the standard deviations of the sectors relative to standard deviations of the aggregate output measures. More simply, sectors that are highly correlated, that are relatively volatile, and relatively important in both economies, are going to lead to highly correlated aggregate output levels. The results above establish that common sector and tradables (manufacturing) sector groupings are more likely to contribute to higher aggregate correlation than other sectors holding these other scale factors constant.[23]

Finally, the results here can be interpreted within the context of the literature that examines the determinants of business cycle synchronization. These studies have emphasized trade and financial linkages, as well as production specialization. The results here support the broad conclusions of this literature. Whether due to common shocks or common sector response to shocks, the common sector effect identified in the sector correlations is indirect support for Imbs' (2004) arguments that the more similar are two economies in production structure the more likely are their business cycles to be synchronized. That said, however, only a subset of the industry sectors are strongly synchronized across the US-Canada border, most notably manufacturing. Interestingly, many of the cross-country studies use indexes of comparable specialization based only on manufacturing (that is,

23. To be more precise, one should calculate the various scale factors; since there are 81 sectors that contribute to the aggregate output correlation (of the 153 cross-sector correlations, only 81 are across-border), a comparative assessment along these lines requires considerable effort. I leave this for future work. Furthermore, given the relatively large role for manufacturing in both economies (in recent years, about 18 per cent in Canada and 14 per cent in the United States), it seems reasonable to accept that the tradables sector involving manufacturing linkages is likely to contribute in an important way to the overall aggregate correlation between the two economies.

manufacturing subsectors), primarily for reasons of data quality.[24] The results here suggest that broad-based conclusions about the interaction between production specialization and business cycle synchronization may not be possible using manufacturing-based specialization indexes—the manufacturing sector seems to behave differently from other sectors in the economy in this regard.

The tradables sector effect, when narrowly defined to manufactures, provides indirect evidence on the importance of trade linkages for the transmission of shocks between the two economies, particularly in the case of the synchronization between Canadian manufactures and US sectors. The fact, however, that there is no tradables sector effect when we use a broad definition of tradables presents a small puzzle. This conclusion does not seem to fit well with the general result from the literature that bilateral trade is important for understanding international business cycle synchronization. One possibility is that we are ignoring the scale factors when assessing the contributions to aggregate correlations. If this does not overturn the result, one might conclude that what matters for aggregate correlations are only certain tradables sectors, in this case, manufacturing broadly defined. It is of some interest whether this result holds more broadly for cross-country synchronization and is not specific to the Canada-US situation.

Conclusion

This paper examines two facets to the relationship between the US and Canadian economies. The first is at an aggregate level and specifically examines whether the relationship between the two economies has been stable. This is done informally by looking at changes in the dynamic correlations of aggregate output growth rates and more formally for the simple correlation between output growth rates. The key result is that there is only weak evidence of an increase in synchronization despite the growing trade and financial integration. The increase in integration is evident, however, in the increased synchronization of Canadian investment and export sectors with the United States.

24. Imbs (2004), for example, uses both manufacturing sectors and broadly defined sectors similar to those here to construct indexes for specialization; however, his discussion focuses on the manufacturing-based specialization index. Similarly, Otto, Voss, and Willard (2003) consider broad- and manufacturing-based specialization indexes, but finds that the manufacturing-based index provides a better fit for the data.

The second facet is the relationships between industry sectors in the United States and Canada. Here, the main result is no evidence of a border effect—Canada and the United States, from this perspective, operate as a large economic region. This suggests that Canada and the United States provide a good benchmark for the effects of broad-based integration on business cycle synchronization that other countries might expect, for example, countries in the European Union, as economic, political, and cultural ties increase. We also provide evidence that, at a coarse level of industry definition, manufactures are a key sector in understanding business cycle synchronization.

Appendix 1
Data

Real GDP data for Canada are taken from CANSIM II Table 3800002, Gross Domestic Product (GDP), Expenditure-Based. All series are seasonally adjusted, chained 1997 dollars. The series labels are as follows:

Table A1.1

Variable	Description	Series label
Y	Gross domestic product (GDP) at market prices	V1992067
C	Personal expenditure on consumer goods and services	V1992044
I	Business gross fixed capital formation	V1992052
G	Government current expenditure on goods and services	V1992049
X	Exports of goods and services	V1992060
$C + I + G - M$	Final domestic demand	V1992068

Note that the definition of final domestic demand is not equal to $C + I + G - M$, as defined here as G excludes public investment.

The industry-sector data are taken from Source OECD STAN Industrial Structural Analysis Database Edition (ISSN 1608–1307) available at: <new.sourceoecd.org/database/stan>. The series descriptions are as follows:

Table A1.2

Variable	Description
AFF	Agriculture, hunting, forestry, and fishing
MQ	Mining and quarrying
MAN	Total manufacturing
EGW	Electricity, gas, and water supply
CON	Construction
WRT	Wholesale and retail trade; restaurants and hotels
TSC	Transport and storage and communication
FIR	Finance, insurance, real estate, and business services
CS	Community social and personal services

Dependent variable transformation for correlation regressions

The following transformation is proposed in Otto, Voss, and Willard (2003) to take account of a dependent variable that is restricted to be between −1 and 1. We assume the following non-linear structure for the regression model:

$$\rho_{ij,\tau} = f(W_{ij,\tau}\beta + \varepsilon_{ij,\tau}).$$

Here, $\rho_{ij,\tau}$ is the correlation measure between two countries or sectors i and j measured over sample period τ taking values between -1 and 1; $W_{ij,\tau}$ is the set of regressors, and $\varepsilon_{ij,\tau}$ is the error term. The function f must map from the real line to the interval -1 to 1; we use the following function:

$$\rho = f(w) = \frac{\exp(w) - 1}{\exp(w) + 1}.$$

As w becomes very large (small), $f(w)$ gets closer to 1 (-1); and $f(0) = 0$. To estimate the model, we transform the LHS variable of equation (1) by the inverse of $f(w)$:

$$f^{-1}(w) = \ln\frac{1+\rho}{1-\rho}.$$

That is, the linear regression we estimate is:

$$\ln\frac{1+\rho_{ij,\tau}}{1-\rho_{ij,\tau}} = \ln z_{ij,\tau} = W_{ij,\tau}\beta + \varepsilon_{ij,\tau}.$$

See Otto, Voss, and Willard (2003) for details concerning predicted values.

Estimation and Testing for Structural Break in Correlation Coefficient

The two series of interest are denoted x_i and y_i for the sample $1 \ldots T$. Both series may contain structural breaks in means and standard deviations, as well as in the correlation coefficient.

The first step is to estimate and test for parameter stability for the first-moment condition for each of x_i and y_i separately:

$$E(x_t - \mu_x) = 0, \quad t = 1 \ldots T$$

$$E(y_t - \mu_y) = 0, \quad t = 1 \ldots T.$$

The mean parameter is estimated using GMM, and the Andrews (1993) test for parameter stability over unknown break points is used to test for structural change and to identify any break point.

Consistent with what is reported in the paper, assume that a break in mean is identified for series x, while no break is identified for series y. Assume that the break date is T_1. Construct the series $x'_{1t} = x_t - \hat{\mu}_{x1}$ for $t = 1 \ldots T_1$ and the series $x'_{2t} = x_t - \hat{\mu}_{x2}$ for $T_1 + 1 \ldots T$. Where

$$\hat{\mu}_{x1} = (1/T_1) \times \sum_{t=1}^{T_1} x_t, \qquad \hat{\mu}_{x2} = (1/(T - T_1)) \times \sum_{t=T_1+1}^{T} x_t.$$

Now stack the two series to obtain x'_t, which has a mean of zero over the whole of the sample.

Then estimate and test for parameter stability for the mean and standard deviation of each series; for example, for x':

$$E(x' - \mu_{x'}) = 0, \quad t = 1, \ldots, T$$

$$E(x'_t - \mu_{x'})^2 - \sigma^2_{x'} = 0, \quad t = 1, \ldots, T.$$

As $\mu_{x'}$ may reasonably be assumed to be constant over the sample, test only for structural change in the standard-deviation parameter $\sigma_{x'}$. For the series, it is not necessary to demean on a subsample basis, so one can proceed as usual to estimate and test for parameter stability of the standard-deviation parameter σ_y. Again, since μ_y may reasonably be assumed to be constant, test only for structural change in the standard-deviation parameter.

Suppose, again consistent with the paper, that both x' and y are found to have a break in standard deviation. For the x' series, this occurs say at time T_x, while for the y series, it occurs at time T_y. For each associated subsample, construct an estimate of the standard-deviation parameters, denoted $\sigma_{1,x'}, \sigma_{2,x'}$ for the x' series and $\sigma_{1,y}, \sigma_{2,y}$ for the y series.

Now standardize each series on a subsample basis. For example, for the first subsample period for the x series, construct a subseries,

$$x''_{1t} = \frac{x'_{1t} - \mu_{1,x'}}{\sigma_{1,x'}}$$

$$\mu_{1,x'} = (1/T_x) \times \sum_{t=1}^{T_x} x'_t$$

$$\sigma^2_{1,x'} = (1/T_x) \times \sum_{t=1}^{T_x} (x'_t - \mu_{1,x'})^2.$$

Having done this for each of the subsamples for each of the series, we can stack the subsample series to create the x'' and y''_t for which we can reasonably assume stable means and standard deviations (of 0 and 1, respectively).

The final step is to estimate and test for parameter stability of the correlation coefficient. The moment conditions are:

$$E(x''_t - \mu_{x''}) = 0, \quad t = 1 \ldots T$$

$$E(x''_t - \mu_{x''})^2 - \sigma^2_{x''} = 0, \quad t = 1 \ldots T$$

$$E(y''_t - \mu_{y''}) = 0, \quad t = 1 \ldots T$$

$$E(y''_t - \mu_{y''})^2 - \sigma^2_{y''} = 0, \quad t = 1 \ldots T$$

$$E(x''_t - \mu_{x''})(y''_t - \mu_{y''}) - \rho_{x'',y''}\sigma_{x''}\sigma_{y''} = 0, \quad t = 1 \ldots T.$$

Since we can assume that $\{\mu_{x''}, \sigma_{x''}, \mu_{y''}, \sigma_{y''}\}$ are constant, we impose this condition and test only for parameter instability of $\rho_{x'',y''}$.

Table A1.3
Sector correlations using transformed dependent variable

Tradable sector	Constant	Within CA	Within US	Within common sector	Within tradables sector
Common sector and tradables sector effects, 1978–2001					
AFF, MQ, MAN, TSC	0.3952	-0.0809	0.0773	0.3932	0.0453
	(0.1203)	(0.1502)	(0.1250)	(0.3165)	(0.1224)
MAN	0.3073	-0.0809	0.0773	0.4409	0.5424
	(0.0766)	(0.1442)	(0.1174)	(0.2649)	(0.1527)
MAN	0.3064	—	—	0.4418	0.5424
	(0.0573)	—	—	(0.2598)	(0.1512)

	Constant	Common sector	MAN(CA): CA	MAN(CA): US	MAN(US): CA	MAN(US): US
Common sector and manufacturing effects, 1978–2001						
	0.3038	0.3743	0.4576	0.8107	0.3629	0.5864
	(0.0572)	(0.2143)	(0.3378)	(0.3044)	(0.2832)	(0.2316)

Notes: The data are as described in Table 4.
Numbers in parentheses are White (1980) heteroscedasticity robust standard errors using weighting matrix HC3 as defined in Davidson and Mackinnon (1993, 552).

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Discussion

Jean-François Perrault

Over the past several decades, global trade flows have expanded exponentially, as the gradual removal of barriers to trade has allowed countries to benefit from comparative advantages. The increasing reliance on trading partners for various types of imports has led to increased economic integration on a global scale: sovereign nations are more tightly linked to foreign trading partners than at any other time. As a result, many economists believe that the economic outcomes of individual states are now more heavily influenced by supranational developments. Thus, global business cycles are viewed as being a more important determinant of national business cycles than in earlier periods. Canada has been in the vanguard of this phenomenon. Most recently, the Free Trade Agreement (FTA) of 1991 and the North American Free Trade Agreement (NAFTA) of 1994 represent milestones in trade liberalization and have served as a clear marker for empirical analyses seeking to identify the impacts of integration on the Canadian economy. Indeed, two other papers presented at this conference look at Canadian business cycle dynamics pre- and post-NAFTA (see Gosselin et al. and Cardarelli and Kose in this volume).

Voss uses a rigorous statistical approach to assess whether increased integration has led to an increase in the synchronization of Canadian and US real GDP growth. In contrast to other studies, Voss does not postulate the existence of a break around the implementation of NATFA. Rather, he establishes the existence of a structural break in the variance and correlation between US and Canadian sectoral output using an endogenous test for such breaks.

Using dynamic correlation analysis, Voss finds no evidence of a border effect. Correlations across sectors in Canada are about the same as those between sectors across the border. Thus, Voss argues that "nation-specific

factors are not particularly important for the business cycles of the two economies" (page 431). In addition, he finds only weak evidence of a break in the correlation between Canadian and US real GDP growth rates. This break is estimated to have occurred in 1980Q1, some distance from the implementation of NAFTA.

Voss's findings contradict much of the research on business cycle coherence done at the Bank of Canada and elsewhere. Indeed, he concludes that there is no border effect, that "Canada and the United States appear to operate, in terms of business cycle synchronization, . . . as one large economic region" (page 414). This contradicts a number of findings, such as McCallum (1995) and Helliwell (1998), which suggest the opposite: that the Canada-US border seems to have an important role in explaining differences in economic structure and business cycle dynamics.[1] Indeed, the findings of Gosselin et al. (this volume) suggest that there is generally a strong domestic component to Canadian regional and sectoral output fluctuations.[2] However, both Voss and Gosselin et al. find that in some sectors, the Canada-US linkages are strong. This is particularly so in the manufacturing sector, in which there seems to be an important degree of synchronization on both sides of the border.

Though Voss's work is a forceful and well thought-out application of correlation analysis, his approach may not be sophisticated enough to tease out findings that are more consistent with previous studies. Notably, his approach does not allow for the explicit identification of the sources of variation of his variables of interest. A structural approach would permit the decomposition of business cycle fluctuations into different components. Perhaps the most promising approach would be to include a regional element to his analysis. In fact, this is almost necessary. To conclude that a sector-specific output variable behaves no differently in Canada than in the United States, one has to be able to identify a Canada-specific industrial disturbance from a North American perspective. In the context of Voss's approach, this could be achieved by assuming three types of disturbances: one that is specific to an industry but common to Canada and the United States; a second that is common to all industries but specific to one country; and a third that is specific to one industry but common to all Canadian regions, or a subset thereof. The empirical analysis could then be augmented by including a regional dummy variable in the simple model used to identify the extent of business cycle synchronization. By doing so, Voss's analysis

1. Note that Helliwell (2002) found that the importance of the border effect diminished rapidly in the late 1980s and early 1990s.

2. A number of studies have also found this result, going back to Gregory, Head, and Raynauld (1997).

would be somewhat more structural than his original specification. This may alter his findings.

A second finding of interest is Voss's conclusion that there is only modest evidence of an increase in business cycle synchronization between Canada and the United States. What is more, the estimated break in the business cycle coherence is estimated to have occurred in 1980Q1. Again, this is an interesting though less controversial finding. Although one may have a natural inclination to assume that Canadian business cycle dynamics changed following the implementation of either the FTA or NAFTA, there is little evidence to suggest that this is the case. Gosselin et al. find only weak evidence that business cycle synchronization increased post-NAFTA. Goss's findings of an earlier break are more consistent with studies that have examined country-specific business cycle dynamics. In Canada, for example, Curtis (2001) finds that the variability of Canadian output permanently increased in the early 1980s, while McConnell and Perez-Quiros (2000) find such a shift in the mid-1980s for the United States.

As might be imagined, Voss's findings, if confirmed by other studies, would have dramatic impacts on the design of economic policy in Canada. From the perspective of a central bank, there is little reason to maintain an independent monetary policy characterized by a flexible exchange rate if most disturbances affect Canada and the United States in the same fashion.[3] In fact, Voss's findings suggest that Canada and the United States satisfy at least some of the criteria for an optimal currency area.

That said, Voss's work does represent an interesting addition to the growing literature on business cycle transmission, notably as it has been applied to the Canada-US economic relationship. Given the intriguing and important policy implications of his findings, more work is required to fully understand the factors driving Voss's results. Is it specific to his approach, as would be suggested by the contradictory findings of other researchers? Or perhaps his results highlight weaknesses in previously used empirical strategies. In either case, further research is warranted, given the importance of this research agenda for policy in Canada.

3. This presupposes that an independent Canadian monetary policy is not a cause of these tight business cycle linkages.

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Economic Integration, the Business Cycle, and Productivity in North America

Roberto Cardarelli and M. Ayhan Kose

Introduction

Important milestones have been reached this year in the history of bilateral economic relations between Canada and the United States. In particular, 2004 marks the 10th anniversary of the North American Free Trade Agreement (NAFTA) and the 15th anniversary of its precursor, the Canada-US Free Trade Agreement (CUSFTA). These agreements have been exceptionally successful in promoting trade and financial flows between the two countries over the years, yielding one of the world's largest bilateral trade and bilateral direct investment relationships (USTR 2003).

Some observers in Canada have recently called for deeper integration with the United States to eliminate remaining barriers to trade. The most ambitious proposals include calls for a "grand bargain," which would couple security and defence-related policies with deeper trade integration, possibly in the context of a customs union or common market (Dobson 2002). Similarly, some proposals have included calls for a monetary union with the United States (Courchene 2003). There have also been more modest and immediately practical proposals, involving suggestions for greater effort towards harmonizing rules, standards, and regulations, in order to reduce the extent to which these arrangements impede trade and efficiency (Goldfarb 2003).

However, other observers have questioned the merits of these proposals and have argued that further economic integration with the United States might not be in the best interests of Canada. In particular, they claim that increased

economic integration between the Canadian and US economies has not contributed to reducing Canada's dependence on natural resources and to narrowing the labour productivity gap between the two countries (Jackson 2003a, 2003b). Moreover, they argue that a customs union with the United States would imply giving up an independent trade policy, which might have an adverse impact on Canada's broader trade policy priorities.

To shed light on the debate about the future direction of economic integration, we analyze the impact of major Canada-US trade agreements on the dynamics of business cycles and productivity. In particular, we address the following questions: First, what has been the impact of the major trade agreements on trade and financial flows between the two countries? Second, what has been the effect of increased economic linkages on the co-movement of business cycles in Canada and the United States? Third, how has the economic integration affected the labour productivity gap between the two economies?

Canada and the United States have taken important steps to promote economic linkages during the past four decades. Section 1 reviews the key provisions of major trade agreements signed by Canada and the United States. The 1965 Canada-US Auto Pact freed cross-border trade in the sector, and led to a significant growth of the Canadian auto industry. In 1989, CUSFTA expanded the coverage of tariff-free trade to almost all sectors, and in 1994, NAFTA broadened the scope of the CUSFTA by including Mexico. The CUSFTA and NAFTA were groundbreaking, insofar as they covered a broad range of sectors, including services and investment, and introduced a unique dispute settlement mechanism.

Isolating the impact of these agreements on the economies of Canada and the United States is a difficult exercise, as various other major factors have affected these countries over the past two decades. Among these factors are the increases in global trade and finance flows during this period, and the different business cycles and economic policies that were implemented in the two countries. For example, after an unprecedented expansion in the 1990s, the US economy went into a recession in 2001 and remained sluggish until mid-2003. In contrast, Canada has enjoyed a prolonged expansionary period since the late 1990s, after the macroeconomic and structural adjustment earlier in the decade. To account for these factors and to provide for a comprehensive assessment of the effects of the trade agreements on Canadian business cycle and productivity dynamics, we document several stylized facts, employ a variety of econometric methods, and review the results of recent research.

In section 2, we examine the impact of the major agreements on trade and financial flows in Canada.[1] In particular, CUSFTA and NAFTA have been associated with substantial increases in trade and financial flows between the two countries. The inception of CUSFTA also affected the dynamics of national and regional trade flows. With exports to the United States rising much faster than imports, the contribution of net exports to the growth of Canadian gross domestic product (GDP) rose rapidly. In addition, after CUSFTA, the average share of international trade in provincial GDP increased much faster than that of interprovincial trade.

In section 3, we study the extent to which there has been an effect on the co-movement of Canada-US business cycles. Increased trade and financial linkages led to significant changes in the dynamics of business cycles in Canada. Canada-US business cycles have become more synchronized, and the rapid growth of intra-industry trade has also contributed to greater cross-country correlations of investment and imports. We also use a dynamic latent factor model to examine the role of common, country-specific, and idiosyncratic factors in driving business cycles in Canada and the United States. The estimation results indicate that, although the common factor has played an increased role in explaining business cycles in Canada and the United States since the early 1980s, country-specific and idiosyncratic factors remain important in Canada.

In section 4, we analyze the impact of economic integration on the labour productivity gap between the two countries. The results indicate that the widening labour productivity gap between the two economies over the 1990s is mainly a reflection of the different evolution of the two countries' industrial structure. However, the negative impact from the different industry specialization between the two countries does not seem to be related to the increased trade integration of Canada and the United States over the 1990s. The increased economic integration with the United States has allowed Canadian firms to benefit from economies of scale and technology transfers, something that appears to have positively contributed to their productivity performance.

In the final section, we conclude with a brief summary of the results and policy implications. The results indicate that economic integration has been associated with a significant increase in business cycle synchronicity, and with convergence in total factor productivity. At the same time, however, the different industrial structure of the two economies implies that they remain subject to substantial country-specific shocks. Differences in industrial

1. Kose, Meredith, and Towe (2004) provide a detailed examination of the impact of NAFTA on the Mexican economy.

structure have also prevented convergence in aggregate labour productivity. Although these findings would seem to weigh against moving towards a monetary union, they also suggest that substantial benefits could be reaped from further reducing the remaining barriers to trade.

1 Trade Agreements Between Canada and the United States

An important step towards promoting Canada-US trade linkages was the 1965 Canada-US Auto Pact. Prior to the Auto Pact, tariffs on cross-border trade in automotive products were high—roughly 7 per cent in Canada and 17 per cent in the United States. The pact eliminated all tariffs faced by producers and led to significant growth in the Canadian auto industry—the industry became highly integrated with the US industry, and transportation equipment became Canada's largest export to the United States (Hummels, Rapoport, and Yi 1998).

The 1989 Canada-US Free Trade Agreement (CUSFTA) introduced free trade in almost all sectors. CUSFTA eliminated most tariffs and other trade barriers in its first ten years, with the average Canadian tariff on manufacturing imports from the United States falling from 3 per cent in 1989 to almost zero in 2001, and the average US tariff on imports from Canada falling from around 4.5 per cent to 0.5 per cent during the same period (Figures 1 and 2). The agreement gave considerable preferential tariff advantage to the other country, since tariffs on imports from third countries remained relatively higher. In addition, CUSFTA substantially reduced non-tariff barriers, provided ground rules covering trade in services and investment, and included various dispute settlement mechanisms (USITC 2003).

The 1994 North American Free Trade Agreement (NAFTA) represented a further milestone.[2] NAFTA created the world's largest free trade area in terms of total GDP, and it is the second largest, in terms of total trade volume, after the European Union. In 2002, total GDP of NAFTA members was more than 25 per cent larger than that of the European Union. Exports (imports) of the European Union constituted roughly 38 (35) per cent of world exports (imports), while exports (imports) of NAFTA accounted for about 18 (25) per cent (DFAIT 2003). In addition, NAFTA was the first

2. Negotiations for NAFTA formally started in June 1991. Since the member countries had held bilateral discussions earlier, negotiations moved forward quickly and were completed in August 1992. The United States and Mexico passed the NAFTA legislation in November 1993, and Canada did the same in December 1993. Finally, NAFTA entered into force on 1 January 1994.

Figure 1
United States: Average tariffs on imports from Canada and world

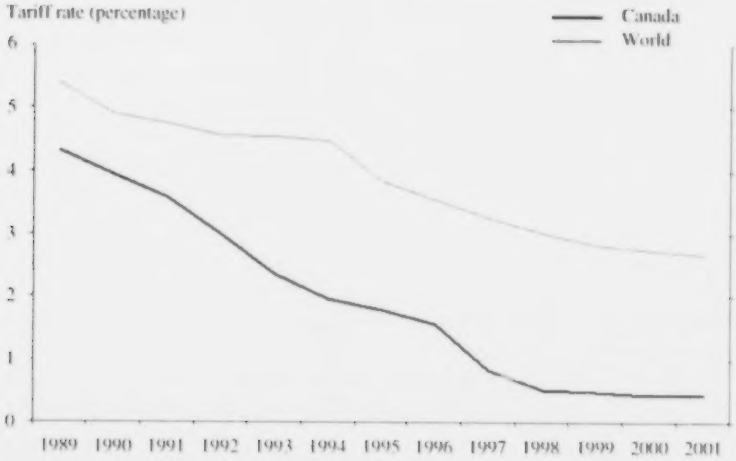
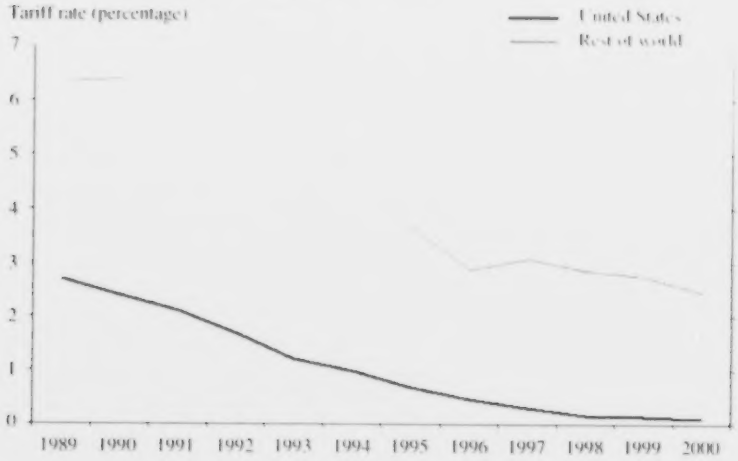


Figure 2
Canada: Average tariffs on manufacturing imports from the United States and rest of world



comprehensive free trade agreement between advanced countries and a developing economy (Mexico).

NAFTA expanded various provisions of CUSFTA and broadened the scope of the agreement by including Mexico.[3] It eliminated the majority of tariffs and other trade barriers in its first ten years and will have phased out most remaining tariffs by 2008 (see Hufbauer and Schott 1992; USITC 2003). Moreover, building on the provisions of CUSFTA, NAFTA included various provisions covering investment flows, financial services, government purchases, and protection of intellectual property rights. For example, NAFTA removed many investment barriers and included clauses protecting the rights of direct investors. NAFTA's financial services provisions covered banking, insurance, and securities industries and provided the right of establishment in these industries, subject to some exceptions. Government procurement provisions of NAFTA eliminated "Buy National" restrictions on the majority of non-defence goods and services that were supplied by firms in North America to the federal and state/provincial governments of the member countries. NAFTA also established comprehensive standards for the protection and enforcement of intellectual property rights in the member countries.

In addition, NAFTA introduced unique mechanisms for settlement of disputes and included side agreements covering labour and environmental issues. In particular, NAFTA established processes dealing with various issues, including appeals of anti-dumping and countervailing duty determinations; resolution of investor-state disputes; and private commercial disputes.[4] NAFTA included two important side agreements: the North American Agreement on Labor Cooperation, aimed at promoting enforcement of domestic labour laws; and the North American Agreement on Environmental Cooperation, established to ensure that trade liberalization and environmental goals were mutually supportive.

However, some sensitive sectors were still protected under NAFTA. For example, NAFTA set out separate agricultural market access requirements between Mexico and the United States, and between Mexico and Canada. When considered in combination with CUSFTA, these provisions established three separate bilateral agreements on agriculture. In addition, NAFTA included comprehensive rules of origin requirements, and products must generally be wholly produced in North America or originate in a

3. CUSFTA is still in force technically, but it has been effectively suspended after the introduction of NAFTA, which has included all the provisions of CUSFTA.

4. The agreement established a Free Trade Commission, which served as the central institution of NAFTA and comprised ministers or similar officials designated by each country.

member country to qualify for NAFTA preferences. Moreover, NAFTA contained safeguard clauses covering import surges from the member countries.

2 Dynamics of Trade and Financial Flows

2.1 Growth of trade flows

Trade flows between Canada and the United States increased significantly after the advent of CUSFTA. Canada's merchandise trade (the sum of exports and imports) to the United States more than doubled in US dollar terms over the period 1988–2002, and trade with the United States, on average, grew more than two times faster than GDP after the inception of CUSFTA (Figure 3a). During the same period, the share of exports to the United States rose from around 30 per cent of GDP to as high as 55 per cent (Figure 3b). By 2002, roughly 90 per cent of Canadian merchandise exports were directed to the United States, a 17 percentage point increase from 1988 (Figure 3c). By contrast, the share of Canadian imports from the United States remained roughly unchanged at around 65 per cent during the same period.

The product mix of Canada-US trade also shifted. Although transportation equipment, along with machinery and electronics, continued to represent a significant fraction of Canada's total trade with the United States, their importance decreased during the period 1989–92 (Table 1). Notably, the share of Canada's exports to the United States associated with primary sectors, including metals and minerals and wood and pulp, also declined somewhat, with sharp increases in apparel and textiles and special transactions (DFAIT 2003). These trends were accompanied by a significant increase in the share of Canada's exports from the agriculture and oil sectors, and to a lesser extent, the manufacturing and service sectors being directed to the United States (Figure 3d).[5]

The inception of CUSFTA also had important national and regional effects in Canada. With exports to the United States rising much faster than imports, the contribution of net exports to GDP growth jumped from about zero during the period 1973–88 to about 0.75 percentage points after the introduction of CUSFTA (Figure 4a). The growth in trade appeared to favour those regions—British Columbia, the Prairies, and the Atlantic region—which previously had relatively weak ties to the US market (Figure 4b). These regions saw a sharp jump in the share of their exports being

5. The information and communication technology (ICT)-producing sector is proxied by the industrial machinery and electrical and electronic product sectors.

Figure 3a
Trade with the United States and GDP

Index, 1980 = 100

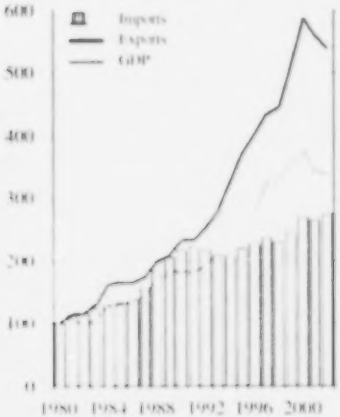


Figure 3b
Trade with the United States as a share of GDP

(Percentage)

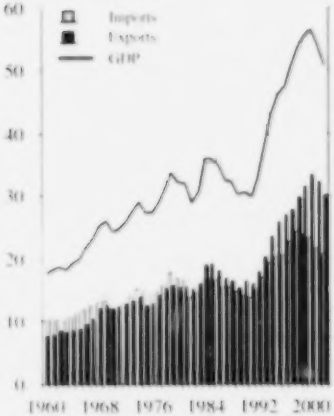


Figure 3c
Trade with the United States as a share of total

(Percentage)

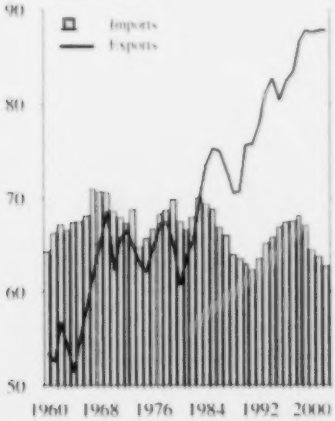


Figure 3d
Canada: Sectoral exports to the United States

Percentage of total sectoral exports

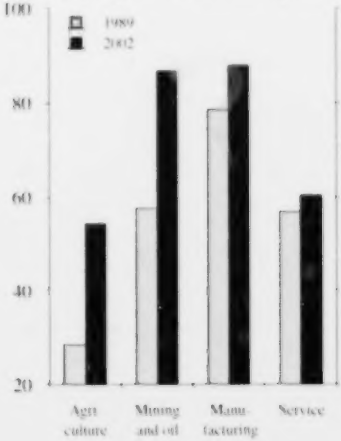


Figure 4a
Contributions to GDP growth

Percentage points

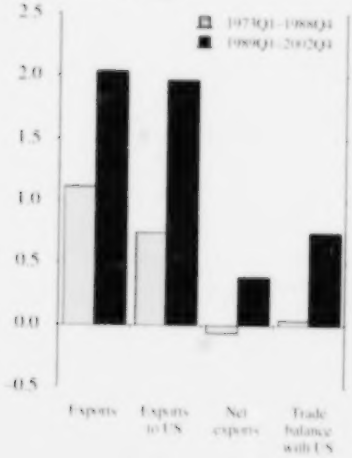


Figure 4b
Exports to the United States by region

Percentage of total regional exports

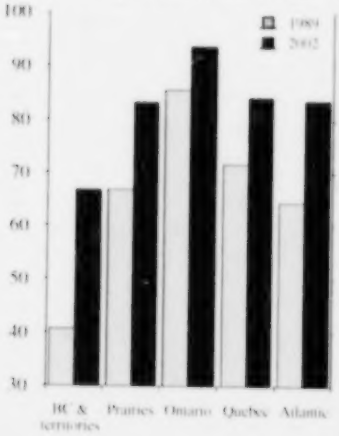


Figure 4c
Regional exports to the United States

In percentage of total
Canadian exports

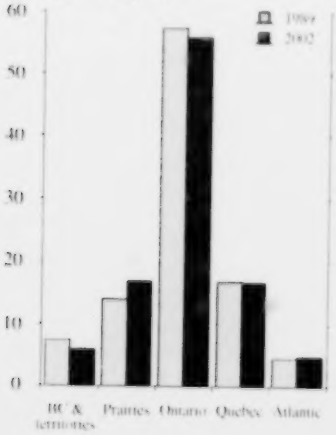


Figure 4d
Vertical specialization

Processed imports as a share
of sectoral merchandise exports

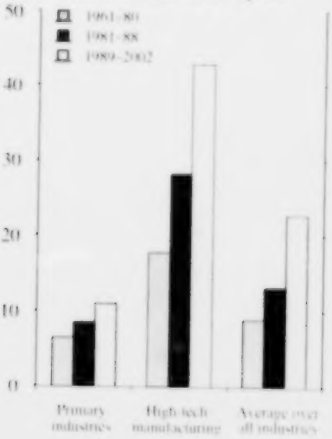


Table 1
Canada: Merchandise trade with the United States
(Share of total exports and imports, percentage)

Exports	1989	2002	Change (1989–2002)
Transportation equipment	32.8	27.0	-5.8
Machinery and electronics	14.6	13.7	-0.9
Metals and minerals	21.3	21.7	0.4
Wood and pulp	15.0	10.5	-4.5
All others	16.4	27.1	10.7
Imports			
Transportation equipment	28.1	25.6	-2.5
Machinery and electronics	33.6	30.6	-3.0
Metals and minerals	11.3	10.9	-0.4
Chemicals and plastic and rubber	10.0	14.8	4.8
All others	17.0	18.2	1.2

Source: DFAIT (2003).

directed to the United States, narrowing the gap with Ontario and Quebec, which had already enjoyed strong trade links to the United States (Figure 4c).

The importance of geographical change in Canadian trade patterns from the traditional east-west trading axis to the international north-south trading one is also emphasized by recent research. In particular, the average share of international trade in provincial GDP increased much faster than that of interprovincial trade after the inception of CUSFTA, and rose from 42 per cent in 1991 to 75 per cent in 2000 (Courchene 2003). For Quebec and Ontario especially, the relative importance of international trade rose tremendously during the 1990s as the United States market became increasingly more important. In particular, Ontario's exports to the United States rose from 25 per cent of its GDP in 1989 to almost 50 per cent in 2001.

A number of recent studies examine the changes in the dynamics of regional trade flows using various gravity models. For example, Wall (2003) studies bilateral trade flows among the NAFTA members using a gravity model. He concludes that NAFTA resulted in a large increase in the trade volume between Central Canada (Ontario and Quebec) and the United States during the 1993–97 period. However, his results also suggest that NAFTA led to a decrease in the amount of trade between Eastern Canada (New Brunswick, Newfoundland, Nova Scotia, and Prince Edward Island), while its impact on the trade flows from Western Canada (Alberta, British Columbia, Manitoba, and Saskatchewan) to the United States was relatively minor. Gu and Sawchuk (2001) study the changes in regional trade flows between Canada

and the United States over the period 1990–98, employing a gravity model that accounts for the effects associated with market size and distance. They document that regional trade flows with the United States rose by 6.7 per cent per year for Ontario, 5.3 per cent for Quebec, 5 per cent for the Prairies, and 4.7 per cent for Atlantic Canada during this period.

Recent research also confirms the significant impact of CUSFTA on Canada-US trade flows. Clausing (2001) analyzes the effect of CUSFTA on commodity-level tariff rates and concludes that more than half of the increase in Canada's exports to the United States during 1989–94 was due to the agreement. Romalis (2002) examines the impact of tariff preference associated with CUSFTA and NAFTA on the trade flows between the member countries and confirms that CUSFTA has had a large impact on Canada's trade share with the United States. Wall (2003) uses a gravity framework and finds that NAFTA accounts for roughly 50 per cent of the increase in the exports of Canada to the United States and approximately 25 per cent of the increase in Canadian imports from the United States. Clausing (2001) concludes that the agreement did not result in any sizable trade diversion, i.e., the expansion of trade was not at the expense of other countries, while Romalis and Wall argue that the agreements induced trade diversion. Schwanen (1997) compares trade in sectors that were liberalized after CUSFTA and NAFTA with others and concludes that exports of Canada to the United States in these sectors rose by 139 per cent and by only 64 per cent in other sectors. Trefler (2001) and Head and Reis (2003) find that CUSFTA appeared to have a positive impact on trade flows. Krueger (1999, 2000) also documents a substantial increase in trade flows between Canada and the United States after NAFTA.

2.2 Changes in the nature of trade

Canada's trade appears to have become more geared towards manufactured goods as a result of the boom in Canada-US trade linkages. The share of manufactures in total exports rose from less than 33 per cent in 1960 to roughly 63 per cent in 2001, with a correspondingly less prominent role played by agriculture and fuels (Table 2). The share of manufacturing imports also increased from less than 70 per cent in 1960 to roughly 83 per cent in 2001. Moreover, over the second half of the 1990s, Canada's tradable sector seems to have evolved rapidly in the direction of high-tech-producing sectors. In particular, while it remains lower than in the United States, Canada's ICT-producing sector has increased its share of aggregate GDP over this period (Table 3).

Recent research analyzes changes in the dynamics of sectoral trade flows between the two countries. For example, Gu and Sawchuk (2001) study the

Table 2
Canada: Composition of trade
(Share of total exports and imports, percentage)

	Exports			Imports		
	1960	1980	2001	1960	1980	2001
Manufactures	32.5	48.1	62.4	69.0	71.7	82.9
Agriculture and food	36.5	23.4	13.0	16.2	9.6	7.0
Fuel and ores	30.4	28.1	18.5	12.3	17.2	7.9

Source: World Bank, *World Development Indicators*.

Table 3
Canada and the United States: Value-added, shares of total
(Percentage)

	Canada		United States	
	1981–95	1995–2000	1981–95	1995–2000
Agriculture	3.2	2.5	2.3	1.8
Mining	6.9	5.6	2.5	1.5
Construction	8.5	6.9	5.3	5.3
Manufacturing	24.0	25.1	22.4	19.5
of which				
Industrial machineries and electrical and electronic equipment	2.7	2.9	5.0	4.4
Transportation	5.5	5.2	4.0	3.8
Communications	3.9	3.7	3.1	3.1
Utilities	4.5	4.5	3.2	2.6
Trade	14.7	14.3	16.4	16.0
FIRE	12.8	14.3	19.0	21.1
Other services	15.9	18.0	21.9	25.3

Note: FIRE = finance, insurance, and real estate.
Source: International Monetary Fund staff estimates.

contributions of various sectors to the increase in trade flows between Canada and the United States. They find that the two high-tech industries, i.e., electronic equipment and industrial machinery, along with the motor vehicle industry, accounted for half of the increase in Canada's trade flows with the United States during the period 1990–98. Their results also indicate that the rapid growth of the two high-tech industries explained more than 50 per cent of the increase, while the rest was attributable to the increased trade intensity in these industries. In addition, Gu and Sawchuk report that although the contribution of the resource and resource-based industries was

relatively small compared with the growth of trade flows between the two countries, these industries still accounted for roughly 20 per cent of the increase in aggregate trade flows.[6]

Trade liberalization has also spurred cross-border vertical integration. For example, the share of Canada's exports based on vertical trade—i.e., the share of export value that is due to the processing of imports at an earlier stage of production—rose by twofold since the inception of CUSFTA (Figure 4d). Dion (1999–2000) finds that there has been a dramatic increase in vertical specialization across manufacturing industries, especially since the late 1980s (which coincides with the inception of CUSFTA). Hummels, Rapoport, and Yi (1998) conclude that the 1965 US-Canada Auto Pact led to a substantial increase in vertical trade in the auto industry.

Intra-industry trade between Canada and the United States has also risen over time. Intra-industry trade plays a major role in Canada's trade with the United States, since it accounts for most of the trade in almost all industries.[7] After the inception of CUSFTA, the importance of intra-industry trade between the two countries rose in several industries, including metal products, machinery, and motor vehicles. For example, the share of intra-industry trade rose from 62 per cent in 1990 to 67 per cent in 1998 in machinery industry (Sawchuk and Sydor 2003). Recent research is unable to establish a clear link between CUSFTA/NAFTA and the increase in intra-industry trade between the two countries during the 1990s (Trefler 2001; Acharya, Sharma, and Rao 2003).

2.3 Growth of financial flows

Trade liberalization has been associated with a significant increase in foreign direct investment (FDI) flows between Canada and the United States. Gross FDI flows increased by more than sevenfold between 1989 and 2002, with similar increases in both directions (Figure 5a). The bulk of the FDI inflows to Canada came from the United States as the average share of inflows from the United States accounted for 68 per cent of total inflows over the period 1989–2002. A tremendous increase in FDI flows occurred after the inception of NAFTA, associated with a small number of mega-

6. These industries include all primary industries and food, beverages, tobacco, leather, wood, paper and allied products, primary metal, non-metallic minerals, and refined petroleum.

7. Schreyer (2001) documents that the extent of manufacturing intra-industry trade of Canada has been high and relatively stable over time. Manufacturing intra-industry trade as a fraction of total manufacturing trade rose from 73.5 per cent over the period 1988–91 to 76.2 per cent during 1996–2000.

Figure 5a
Canada-US FDI flows

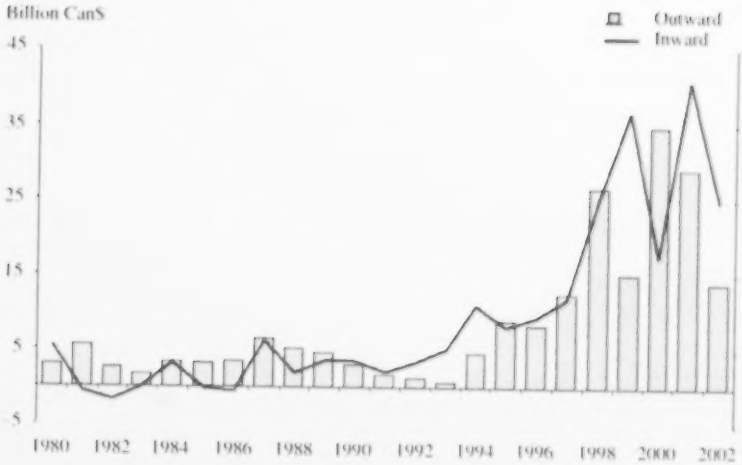
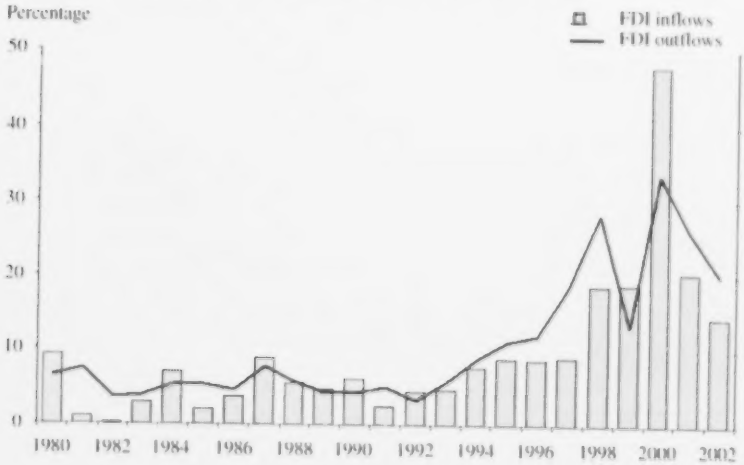


Figure 5b
Canada: FDI flows as a fraction of domestic investment



mergers (DFAIT 2003).[8] As a result, the average share of FDI inflows in Canada's domestic gross fixed capital formation (investment) rose from 6 per cent in the 1986–88 period to 26 per cent over the 2000–02 period (Figure 5b). However, recent research is unable to show that CUSFTA/NAFTA has had any discernible impact on FDI flows between the two countries (Schwanen 1997; Globerman and Shapiro 2003).

3 Economic Integration and the Dynamics of Business Cycles

3.1 A brief survey of the literature

In theory, increased trade linkages have ambiguous effects on the co-movement of business cycles. Stronger trade linkages can result in more highly correlated business cycles by increasing demand- and supply-side spillovers. Increased intra-industry specialization across countries can also increase cyclical co-movement, if industry-specific shocks are important in driving business cycles. However, the degree of co-movement might fall if inter-industry (rather than intra-industry) trade linkages are spurred and industry-specific shocks are important in driving business cycles (Kose and Yi 2001).

The effect of financial flows on business cycle correlations also depends on the nature of shocks and specialization patterns. For example, stronger financial linkages could generate higher cross-country synchronization of output by allowing easier spillovers of demand-side shocks. However, financial linkages could help facilitate investment and specialization of production, thereby increasing countries' exposure to industry- or country-specific shocks. This could lead to a decrease in the degree of output correlations, while inducing stronger co-movement of consumption across countries (Kalemli-Ozcan, Sorensen, and Yosha 2003).

These competing factors complicate evaluations of the impact of trade agreements on Canada-US business cycles. The increase in vertical specialization and intra-industry trade between Canada and the United States would typically be expected to strengthen business cycle linkages over time. However, inter-industry trade and differences in industrial structure are still considerable, implying that sector-specific shocks could lead to divergence of cycles. For example, the fact that Canada experienced a shallower downturn and a relatively stronger recovery from the 2000

8. Although there was a significant increase in the volume of FDI flows from the United States to Canada in the period 1989–2002, the US share of Canadian FDI stock remained quite stable at around 65 per cent.

recession than the United States has often been ascribed to Canada's smaller ICT sector, as well as to the effects of a relatively depreciated exchange rate and the improvement in global commodity prices.

Recent empirical studies are inconclusive regarding the extent to which business cycles in the two countries have become more synchronized. Some of these studies argue that there has been an increase in the extent of synchronization of business cycles in Canada and the United States. For example, Kose, Prasad, and Terrones (2004) study cross-country correlations of business cycle fluctuations in several macroeconomic aggregates of the G-7 countries over the three different periods: the Bretton Woods (BW) period of fixed exchange rates (1960Q1–1972Q4); the common-shocks period, during which the world economy was buffeted by severe shocks to oil prices and subsequent disinflation (1973Q1–1986Q2); and the globalization period (1986Q3–2002Q4), which coincided with dramatic increases in the volume of international trade and financial flows. They report that correlations of output and consumption fluctuations in Canada and the United States were higher in the globalization period than in the BW period. Kose, Otrok, and Whiteman (2003) and Stock and Watson (2003) find that the importance of global factors in explaining business cycles in both countries has risen since the 1980s and conclude that business cycle linkages between Canada and the United States have become stronger.

Others conclude that there has been no major change in the degree of synchronization of business cycles in the two countries. Doyle and Faust (2003) show that there has been no statistically significant change in the correlations of the growth rates of GDP of Canada and the United States since the 1960s, with similar results reported by Helbling and Bayoumi (2003). Heathcote and Perri (2003) show that the US business cycle has become less correlated with the aggregate cycle of Europe, Canada, and Japan since the 1960s.

3.2 How did the free trade agreements change the business cycle in Canada?

Inspection of simple correlations suggests an increase in the co-movement of business cycles in Canada and the United States. For example, an increase is clearly evident in the 20-year rolling correlations in cyclical deviations of Canada's output, consumption, and investment and cyclical deviations in the United States, with a particularly sharp increase in the case of investment and imports after the inception of CUSFTA (Figures 6 and 7). At the same time, the Canadian and US business cycles have become less correlated with cycles in other G-3 countries (Germany and Japan).

Figure 6
Canada and the United States: Co-movement of economic variables

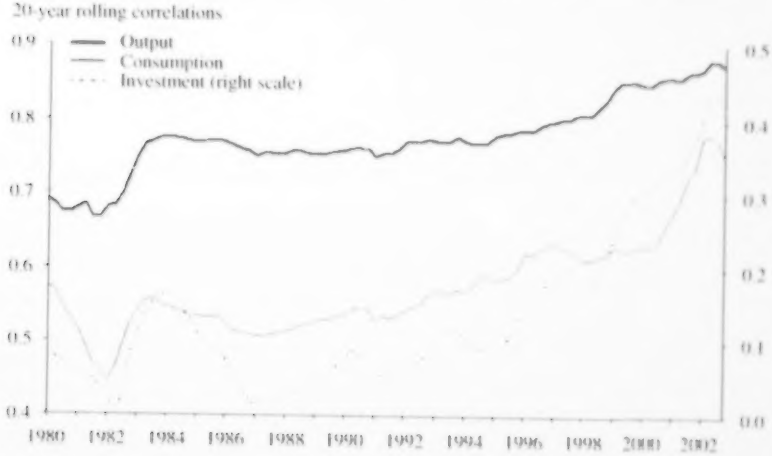
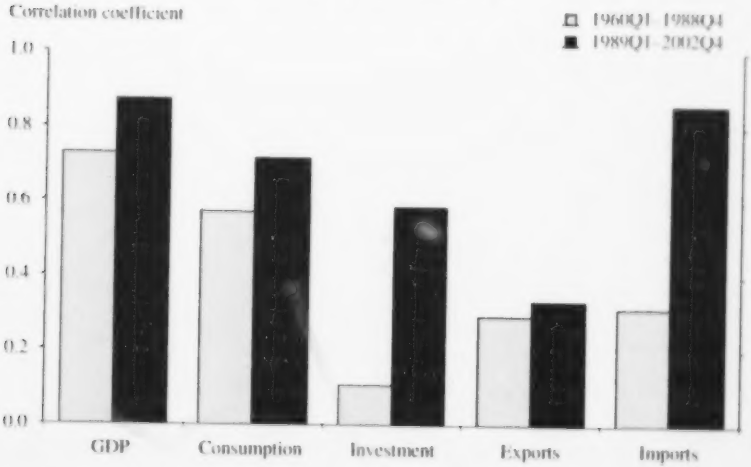


Figure 7
Canada and the United States: Co-movement of economic variables



While they are useful in describing some general patterns, simple correlations do not allow conclusive statements about the changes in the degree of business cycle co-movement. First, cross-country correlations capture only the contemporaneous co-movement in macroeconomic variables, and do not account for common fluctuations associated with "leads" and "lags." Second, correlations can account for the degree of co-movement in only a single macroeconomic variable. Moreover, correlations are not helpful to analyze the relative importance of different types of factors and/or shocks in explaining business cycle co-movement.

A dynamic latent factor model is estimated to further analyze the sources of the apparent increase in convergence of business cycles in Canada and the United States. The model (employed in Kose, Otrok, and Whiteman 2003) allows estimation of the extent to which common or country-specific factors explain the changes in the co-movement, and also helps take into account potentially important contemporaneous, as well as temporal, covariation among different macroeconomic variables.

The model focuses on the dynamic co-movement of output, consumption, and investment across Canada and the G-3 countries. It decomposes macroeconomic fluctuations into (i) a "common" factor that is common across all variables/countries; (ii) "country-specific" factors, which are common across the main aggregates within a country; and (iii) "idiosyncratic" factors, which are specific to total output, consumption, and investment (idiosyncratic errors). In particular, there are three types of factors in the model: the common factor (f^{common}), four country-specific factors ($f_i^{country}$, one per country), and 12 factors specific to each variable ($\varepsilon_{i,t}$, the "unexplained" idiosyncratic errors). Observable variables are denoted by $y_{i,t}$, for $i = 1, \ldots, 12$, and $t = 1960Q1–2002Q4$. Thus, for observable i:

$$y_{it} = a_i + b_i^{common} f_t^{common} + b_i^{country} f_{n,t}^{country} + \varepsilon_{i,t}$$

$$E\varepsilon_{i,t}\varepsilon_{j,t-s} = 0 \qquad for \quad i \neq j, \tag{1}$$

where n denotes the country number. Output, consumption, and investment data for each of four countries are used as observables, so there are 12 time series to be "explained" by the five factors and 12 "regression" equations to be estimated.

The estimated factors capture some of the major economic events since 1960. In particular, casual observation suggests that the common factor has been an important force behind most of the major business cycle episodes of the past 40 years. In particular, the behaviour of the common factor is consistent with the steady expansionary period of the 1960s; the boom of the

early 1970s; the recessions of the mid-1970s, the early 1980s, and the 1990s; the expansionary period of the late 1980s; and the global downturn of 2001–02 (Figure 8a). At the same time, the Canada-specific country factor was also important in explaining some of Canada's major cyclical episodes, including the recessions of 1982 and 1991, the economic slowdown in 2001, and the booms of the 1960s and the second half of the 1990s (Figure 8b). The estimated US country factor captures some of the National Bureau of Economic Research reference cycle dates including the recessions of 1970, 1975, 1980, and 1982, and the booms of 1973, 1980, and 1981 (Figure 8c). Both the common and US country factors capture the highly synchronized and severe downturn in 2000.

The importance of the common factor in driving business cycles is analyzed using variance decompositions. To measure the relative contributions of the common, country, and idiosyncratic factors to variations in aggregate variables in each country, the variance of each macroeconomic aggregate is decomposed into the fraction that is due to each of the two factors and the idiosyncratic component in three different time periods. Specifically, the fraction of variance of each macroeconomic aggregate explained by the following factors is computed: (i) a common factor that is common across all variables/countries; (ii) country-specific factors, which are common across the main aggregates within a country; and (iii) factors specific to each variable.

During the period 1960Q1–2002Q4, all three factors have played major roles in accounting for business cycle fluctuations in Canada. Indeed, while the common factor has been important, it explains only about 10 per cent of Canada's output volatility, with the country and idiosyncratic factors explaining the bulk of the volatility for the period 1960Q1–2002Q4 (Figure 9a). By contrast, the common factor is relatively more important in Germany and Japan, explaining more than 25 per cent of output volatility in Japan.

However, the common factor has played an increased role in explaining business cycles in Canada and the United States since the early 1980s. Comparing estimates of the model calculated over two separate sub-periods—1960Q1–1981Q2 and 1981Q3–2002Q4—shows that the share of Canada's output variance explained by the common factor roughly tripled in the later period (Figure 9b). Moreover, the share of investment due to the common factor rose by fourfold during the second period, and the role of the common factor in explaining consumption variance increased from less than 5 per cent to roughly 40 per cent (Figures 9c and 9d). Although the importance of the common factor also increased for the United States, the increase was smaller than that for Canada.

Figure 8a
World factor

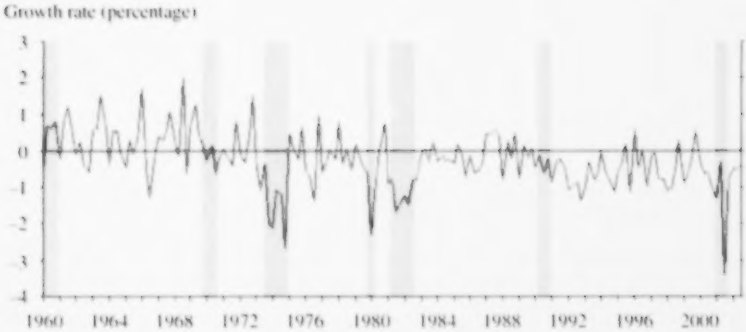


Figure 8b
Canada: Country factor and GDP

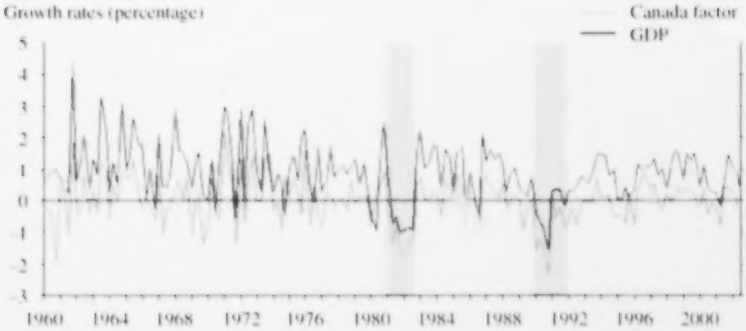


Figure 8c
United States: Country factor and GDP

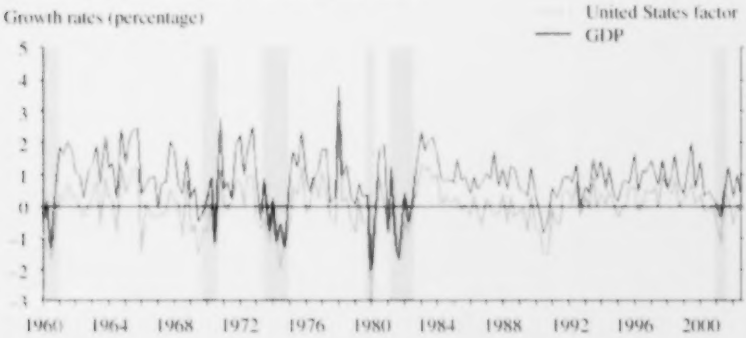


Figure 9a
Variance of output explained by each factor (1960Q1–2002Q4)

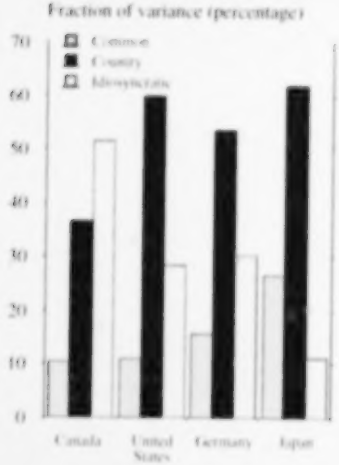


Figure 9b
Variance of output explained by the common factor

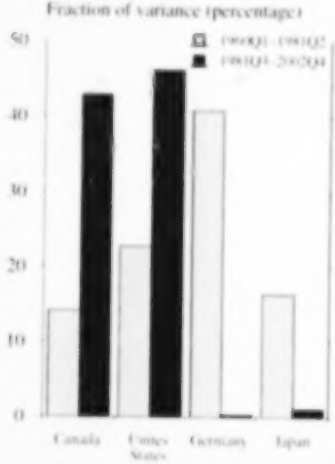


Figure 9c
Variance of consumption explained by the common factor

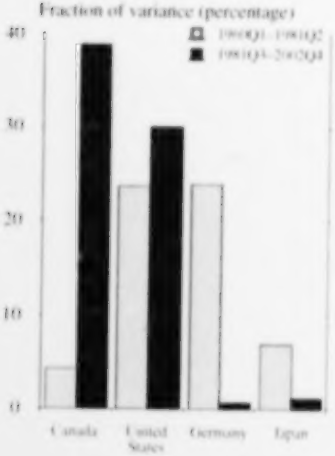
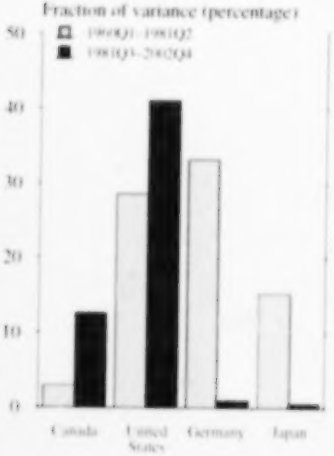


Figure 9d
Variance of investment explained by the common factor



Nonetheless, country-specific and idiosyncratic factors remain important in Canada. The country-specific factor still accounted for more than 10 per cent of volatility of each variable in the second period, and the majority of business cycle variation is still attributed to the idiosyncratic factor (Table 4). The country-specific and idiosyncratic factors also explained over 50 per cent of business cycle variation in the United States.

By contrast, the common factor became less important in explaining output volatility in Germany and Japan during the period 1981Q3–2002Q4. This likely reflects the relative importance of domestic forces that have swamped the importance of increased trade and financial linkages during the past two decades. The Japanese economy has been struggling with a variety of structural problems as it has suffered from a sharp fall in asset prices and a severe banking crisis since the early 1990s. The German economy has been affected by the aftershocks of unification during the same period. In addition, the share of trade with these two countries has decreased in both Canada and the United States during the 1990s.

The important role played by country-specific and idiosyncratic factors in explaining Canadian business cycles suggests that there are significant benefits associated with exchange rate flexibility. This result is consistent with the findings in some recent studies. For example, Murray, Schembri, and St-Amant (2003) document that Canada and the United States are subjected to asymmetric shocks and a flexible exchange rate regime plays a critical role in insulating the Canadian economy from the adverse impact of such shocks. Carr and Floyd (2002) also find that asymmetric real shocks account for a substantial fraction of exchange rate variation in Canada, suggesting that there are benefits from having a flexible regime. Arora and Jeanne (2001) argue that exchange rate flexibility has not slowed the pace of Canada-US economic integration and has been useful in isolating the Canadian economy from asymmetric external shocks.[9]

There have also been important changes in the dynamics of volatility of business cycles in Canada after the inception of CUSFTA. For example, the volatility of business cycle fluctuations in Canada has become less volatile during the 1990s (Figure 10). Debs (2001) finds that there was a structural break in the volatility of Canadian real GDP growth in the first quarter of 1991. The standard deviation of US real GDP growth has also declined significantly since the mid-1980s, and this has been the case for the rest of the G-7, except for Japan, where output volatility has increased in the past

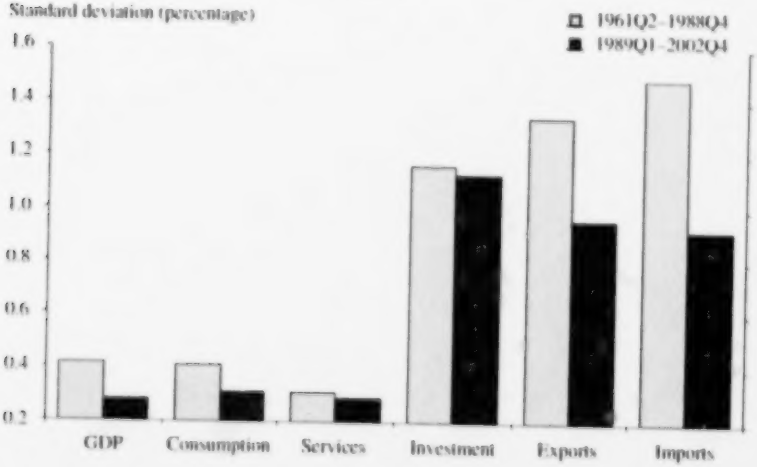
9. Murray (2000) and Bayoumi and Eichengreen (1994) also conclude that the flexible exchange rate regime is beneficial to Canada. Lafrance and St-Amant (1999) provide a review of recent studies about optimal currency areas.

Table 4
Variance decompositions
(Percentage)

Factors/ Periods	Output 33%	Output median	Output 66%	Consumption 33%	Consumption median	Consumption 66%	Investment 33%	Investment median	Investment 66%
					Canada				
1960Q1–1981Q2									
Common	10.98	14.29	17.93	2.70	4.28	6.25	1.58	2.83	4.49
Country	13.64	17.96	22.49	15.06	19.65	24.56	16.95	22.13	28.01
Idiosyncratic	61.60	65.95	70.36	70.68	75.06	79.19	68.56	73.88	79.32
1981Q3–2002Q4									
Common	36.94	42.92	48.11	33.36	38.78	43.38	9.36	12.59	15.88
Country	6.34	10.60	15.39	8.13	13.08	18.91	5.04	10.30	15.92
Idiosyncratic	41.67	45.26	49.32	43.28	46.98	50.69	70.75	75.97	79.91
					United States				
1960Q1–1981Q2									
Common	18.54	22.65	27.37	19.78	23.72	28.36	24.55	28.60	32.76
Country	40.46	46.17	51.30	23.66	28.56	33.09	37.90	42.41	46.83
Idiosyncratic	28.15	30.55	33.17	44.70	47.25	49.49	25.91	28.59	31.51
1981Q3–2002Q4									
Common	40.18	46.18	51.48	25.80	29.97	33.64	35.83	41.07	46.44
Country	4.81	9.65	14.99	4.03	7.87	12.22	8.50	15.15	22.24
Idiosyncratic	39.69	42.88	46.00	58.32	61.09	63.84	38.13	42.39	46.90

Note: 33 per cent and 66 per cent refer to the confidence intervals of the median.
Source: International Monetary Fund staff calculations.

Figure 10
Canada: Volatility of business cycles



decade. Explanations for the increased stability of Canadian and US output have centred on the increasing importance of the "new economy," the declining importance of industrial versus service sector activity, the employment of improved inventory management techniques, and increased effectiveness of monetary policy (Debs 2001; Blanchard and Simon 2001).

4 Economic Integration and Productivity

4.1 A brief survey of the literature

Despite the close integration between the Canadian and US economies, the labour productivity gap between the two countries has widened over the past two decades (Figure 11). While a greater use of labour resources has allowed Canada to narrow the gap with the United States in terms of per capita income from the mid-1990s, convergence has been held back by the more modest pace of Canadian labour productivity growth.

A copious number of studies have sought to analyze the factors behind the productivity gap between Canada and the United States (see Crawford 2002 and Macklem 2003). Among the explanations offered are the following:

- Different size of the ICT-producing sector: Some studies have attributed most of the post-1995 acceleration of labour productivity in the United States to the exceptional total factor productivity (TFP) performance of the ICT-producing sector (e.g., Gordon 2003 and Harchaoui and Tarkhani 2002). Given its smaller ICT-producing sector, these studies suggest that Canada is at a relative disadvantage in reaping the benefit of the ICT productivity wave. For example, Harchaoui and Tarkhani show that the size of Canada's ICT-producing sector increased from around 2 per cent of GDP in 1981 to around 4 per cent of GDP on average over the second half of the 1990s, but remained below the US share, which was around 6 per cent of GDP over this period.
- Different contribution from ICT capital accumulation: The widespread adoption of ICT capital assets has been regarded as a key factor behind the strong labour productivity growth in the United States.[10] Harchaoui and Tarkhani (2002) show that Canada's business sector also experienced solid growth in ICT capital services over the 1981–2000 period, at levels comparable to if not higher than the United States

10. See, for example, Oliner and Sichel (2002) and Jorgenson, Ho, and Stiroh (2005).

Figure 11
United States and Canada: Income and productivity indicators

(Table 5).[11] Nonetheless, the contribution from ICT capital deepening to labour productivity growth is generally estimated to be lower in Canada than in the United States, mainly reflecting the lower estimated marginal productivity of ICT capital and the lower ICT capital intensity in Canada.[12]

- Differences in the share and productivity performance of small and medium-size enterprises (SMEs): In the Canadian manufacturing sector, SMEs (i.e., firms with less than 500 employees) accounted for 75 per cent of total manufacturing employment, compared to around 60 per cent in the United States in 1997. Not only has the weight of SMEs in the Canadian economy increased over the past two decades, but some studies have found these firms to be less productive relative to their US

11. The faster growth in ICT capital services in Canada might be partly explained by differences in the capital-asset depreciation rates used by Statistics Canada and the Bureau of Labor Statistics. In particular, Statistics Canada uses higher depreciation rates for ICT assets, something that might lead to a faster growth of their capital services (see Ho, Rao, and Tang, 2003).

12. See Khan and Santos (2002); Harchaoui and Tarkhani (2002); Armstrong et al. (2002); and Ho, Rao, and Tang (2003). Both Armstrong et al. and Harchaoui and Tarkhani find that ICT capital deepening has contributed around 1/4 per cent to the average annual labour productivity growth in Canada over the 1995–2000 period, up only slightly compared to the 1981–2000 period. The equivalent figure for the United States is estimated between 1/2 per cent (Oliner and Sichel 2002) and 2/3 per cent (Jorgenson, Ho, and Stiroh 2005).

Table 5
Canada and the United States: ICT capital accumulation
(Percentage)

	1981–95		1995–2001	
	Canada	United States	Canada	United States
Investment (average rate of growth)[a]				
Computers	25.8	28.0	39.8	39.3
Software	19.2	16.6	10.2	19.8
Communications	4.5	4.8	17.9	12.2
Capital services (average rate of growth)[b]				
All assets	3.0	3.4	4.3	5.4
ICT	16.9	14.9	18.4	21.3
Computers	27.1	23.9	32.9	41.8
Software	14.5	15.0	7.2	16.4
Communications	7.4	6.3	12.2	8.5
ICT share of capital income[b]	6.3	10.9	8.3	15.3
ICT share of capital stock[c]	3.9	7.0	6.4	11.7

a. Source: Haver Analytics.
b. Source: Harchaoui and Tarkhani (2002).
c. Sources: Armstrong et al. (2002) for Canada and the Bureau of Economic Analysis for the United States.
Note: Values are for 1981 and 2000.

counterparts. For example, Baldwin and Tang (2003) show that around 0.25 percentage point of the labour productivity gap in the manufacturing sector in 1997 was due to the larger share of SMEs in Canada compared to the United States, and 0.5 percentage point to the lower productivity of SMEs in Canada.

- Differences in the share and income of self-employed: The difference in labour-productivity growth between Canada and the United States in the 1990s has also been attributed to the faster growth of self-employment in Canada and the poorer income performance of this group compared with the United States (Baldwin and Chowhan 2003).

Less relevant factors include:

- Differences in national accounts statistics: While differences remain, the methodology used by national statistical agencies to measure labour and TFP has been converging. In particular, both the US Bureau of Labor Statistics and Statistics Canada now use hedonic prices and include purchase of computer software in the national account measures of investment.
- Differences in the regulatory burden in labour and product markets: Gust and Marquez (2004) find that countries with a more burdensome regulatory framework tend to have lower TFP growth. However,

notwithstanding the difficulties in building comparable indexes of regulatory burden across countries, empirical evidence does not reveal a large difference between Canada and the United States in terms of labour and product market legislation and institutions.[13]

The role of trade linkages and of different industrial structures in driving the labour productivity gap is explored in this section by conducting level and growth accounting at a sectoral level. Using industry data allows assessing: i) whether the lack of aggregate convergence is masking significant variation in sectoral productivity dynamics; and ii) the extent to which the productivity differences between the two countries reflect differences in their industrial structure and/or in the performance of specific industries.

4.2 Sectoral growth accounting

The analysis below uses a traditional growth accounting framework. This approach attributes labour productivity growth (value added per hours worked, y_t) to the contribution of three factors: the improvement in labour quality (H_t), weighted by the labour income share of value added (β_t); capital deepening (proxied by the flow of capital services per hours worked, k_t), weighted by the capital income share of value added (α_t); and TFP (denoted by A_t):[14]

$$\dot{y}_t = \alpha_t \dot{k}_t + \beta_t \dot{H}_t + \dot{A}_t. \tag{2}$$

Following Hall and Jones (1996), the log-TFP differential between Canada and the United States for industry i is obtained by subtracting the weighted average of the log-difference in human and physical capital inputs from the log-difference in value added:

$$\ln\left(\frac{TFP_{i,t}^{Can}}{TFP_{i,t}^{US}}\right) = \ln\left(\frac{y_{i,t}^{Can}}{y_{i,t}^{US}}\right) - \left[\frac{1}{2}(\alpha_{k,i,t}^{Can} + \alpha_{k,i,t}^{US})\ln\left(\frac{k_{i,t}^{Can}}{k_{i,t}^{US}}\right)\right.$$

$$\left. + \frac{1}{2}(\alpha_{h,i,t}^{Can} + \alpha_{h,i,t}^{US})\ln\left(\frac{H_{i,t}^{Can}}{H_{i,t}^{US}}\right)\right]. \tag{3}$$

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13. Based on the regulatory variables they use, Canada is lagging the United States according to the Organisation for Economic Co-operation and Development (OECD) employment protection legislation index, but is leading the United States according to the World Economic Forum's regulatory burden index.

14. The dot over the variables denotes percentage growth rates. For a more detailed discussion of the methodology, see Jorgenson, Ho, and Stiroh (2005).

where Canadian value added and capital stock are expressed in US dollars using industry-specific conversion rates derived from Lee and Tang (2001).[15]

Labour and capital inputs for both Canada and the United States are adjusted for quality changes using the same methodology. In particular, labour quality (*Ht*) is the difference between the growth of hours worked and the growth of labour input, obtained by weighting the hours of different types of labour (in terms of educational attainment, age, and gender) by their marginal productivity (proxied by their relative compensation). Similarly, capital services are obtained by weighting the growth rates of different capital assets, using their estimated marginal productivity (proxied by rental prices) as weights. Within this framework, the estimates of labour and capital inputs capture the effect of substituting towards inputs with a higher marginal productivity (e.g., ICT capital and higher educated labour). In turn, this allows the estimates of TFP to better proxy the impact of technical and organizational changes on productivity.

Table 6 shows Canadian and US industries' average labour productivity growth, and the contribution from the three proximate causes. The results are shown separately for the period 1982–2000, as well as the pre- and post-1995 period. The table also shows average labour productivity growth for the entire business sector, aggregated over the 23 sectors considered.[16]

There are two major results:

- Canadian aggregate labour productivity grew by an average annual 0.3 percentage point less than in the United States over the whole period, but the gap in growth rates widened to an average 0.8 percentage point in the post-1995 period. These estimates are broadly consistent with the

15. Lee and Tang (2001) estimated relative Canada-US TFP levels for 1993. As the real GDP and capital stock data in equation (3) are expressed in 1996 (Fisher-chain-weighted) dollars, the Lee and Tang industry conversion rates are updated to 1996 using growth differentials in industries' value-added deflators.

16. Consistent with Schreyer (2001), total labour productivity growth is obtained as the weighted average of labour productivities across industries using value-added shares as weights, plus a reallocation term that reflects the economy's ability to move labour resources to those sectors with a higher-than-average level of labour productivity. Given that aggregate TFP and contributions from labour quality and capital deepening are obtained as weighted averages of industries figures using value-added shares as weights, their sum is different than total labour productivity, the difference being the reallocation factor.

Table 6

Canada and the United States: Productivity growth, 1982–2000

(Percentage)

	Canada				United States			
	Labour productivity	Contribution from:			Labour productivity	Contribution from:		
		Capital	Labour quality	TFP		Capital	Labour quality	TFP
Agriculture	3.7	0.1	0.5	3.1	4.3	0.3	0.3	3.7
Mining	2.2	2.1	0.2	–0.1	1.8	2.9	0.2	–1.3
Construction	–0.6	0.1	0.3	–1.0	–0.1	–0.1	0.4	–0.4
Food, beverage, and tobacco	1.3	0.5	0.1	0.7	0.6	0.9	0.2	–0.5
Rubber and plastic	2.2	0.0	0.1	2.1	4.3	0.6	0.3	3.3
Textiles, apparel, and leather	2.5	0.5	0.5	1.5	3.0	1.0	0.5	1.5
Lumber and wood	2.0	0.3	0.4	1.3	0.1	–0.6	0.4	0.2
Furniture and fixtures	1.3	–0.5	0.2	1.7	1.0	0.3	0.6	0.2
Paper and allied products	3.2	1.9	0.2	1.1	1.5	1.0	0.3	0.2
Printing and publishing	–0.7	0.3	0.3	–1.3	–1.0	1.1	0.3	–2.3
Primary metal	5.2	0.7	0.3	4.3	2.1	0.7	0.4	1.0
Fabricated metal	1.5	–0.4	0.2	1.6	2.2	0.4	0.4	1.3
Ind. mach. and elect. equipment	5.8	1.3	0.3	4.2	11.0	1.3	0.5	9.2
Transportation equipment	4.2	1.1	0.1	3.0	2.2	0.5	0.2	1.5
Non-metallic mineral products	2.2	–0.4	0.2	2.4	2.2	0.3	0.4	1.5
Chemicals and chemical products	4.1	0.1	0.2	3.8	3.7	1.4	0.3	2.0
Other manufacturing industries	1.4	0.4	0.3	0.7	5.7	1.1	0.4	4.2
Transportation	2.3	0.5	0.4	1.4	1.7	–0.1	0.3	1.5
Communications	3.1	1.8	0.8	0.5	3.9	2.8	0.2	0.9
Utilities	1.3	0.1	0.1	1.1	3.1	2.0	0.1	0.9
Trade	2.4	0.5	0.5	1.3	3.5	1.2	0.2	2.0
FIRE	1.7	1.5	0.5	–0.3	1.2	1.5	0.2	–0.5
Other services	–0.2	0.8	0.7	–1.7	–0.2	0.6	0.2	–1.1
Total	1.6	0.8	0.4	0.6	1.9	1.1	0.3	0.8

(cont'd)

Table 6 (cont'd)

Canada and the United States: Productivity growth, 1982–1995

(Percentage)

	Canada				United States			
	Labour productivity	Contribution from:			Labour productivity	Contribution from:		
		Capital	Labour quality	TFP		Capital	Labour quality	TFP
Agriculture	3.0	–0.7	0.6	3.1	3.7	0.1	0.4	3.2
Mining	3.3	1.8	0.21	1.2	3.0	3.1	0.3	2.2
Construction	–0.6	0.2	0.3	–1.1	–0.1	–0.3	0.5	–0.3
Food, beverage, and tobacco	1.6	0.3	0.3	1.0	2.5	0.7	0.2	1.5
Rubber and plastic	3.2	0.5	0.3	2.4	4.1	0.3	0.4	3.4
Textiles, apparel, and leather	2.5	0.6	0.6	1.3	3.1	0.7	0.6	1.8
Lumber and wood	1.9	0.2	0.4	1.3	0.5	–0.9	0.5	0.9
Furniture and fixtures	0.8	–0.1	0.3	0.6	0.9	0.2	0.7	0.0
Paper and allied products	3.1	1.8	0.4	0.9	1.5	0.9	0.4	0.2
Printing and publishing	–1.2	0.4	0.4	–2.0	–1.4	0.8	0.3	–2.6
Primary metal	5.8	0.7	0.4	4.6	1.9	0.7	0.4	0.8
Fabricated metal	1.3	–0.1	0.3	1.0	2.5	0.4	0.4	1.7
Ind. mach. and elect. equipment	5.4	1.1	0.7	3.6	9.0	0.9	0.5	7.6
Transportation equipment	4.1	0.8	0.3	3.0	2.2	0.4	0.2	1.5
Non-metallic mineral products	1.3	–0.2	0.3	1.2	2.6	–0.1	0.4	2.2
Chemicals and chemical products	4.2	0.1	0.3	3.8	4.2	1.2	0.3	2.7
Other manufacturing industries	1.6	0.7	0.4	0.4	5.3	1.0	0.4	4.0
Transportation	2.5	0.4	0.5	1.7	1.5	–0.6	0.3	1.7
Communications	2.9	1.3	0.3	1.2	4.5	3.0	0.2	1.3
Utilities	0.5	0.4	0.2	–0.1	3.0	1.8	0.2	1.1
Trade	1.9	0.4	0.5	1.0	2.3	1.0	0.3	1.0
FIRE	1.4	1.6	0.6	–0.8	0.7	1.3	0.2	–0.9
Other services	–0.4	0.9	0.7	–1.9	–0.4	0.5	0.2	–1.0
Total	1.6	0.8	0.5	0.5	1.6	0.9	0.3	0.7

(cont'd)

Table 6 (cont'd)

Canada and the United States: Productivity growth, 1995–2000

(Percentage)

	Canada				United States			
	Labour productivity	Contribution from:			Labour productivity	Contribution from:		
		Capital	Labour quality	TFP		Capital	Labour quality	TFP
Agriculture	5.3	2.2	0.3	2.8	3.2	0.6	0.2	2.4
Mining	-0.8	2.5	0.1	-3.4	-1.0	1.9	0.0	-2.9
Construction	-0.4	0.0	0.2	-0.6	-0.5	0.5	0.2	-1.2
Food, beverage, and tobacco	0.7	1.0	-0.4	0.1	-0.7	1.3	0.1	-2.2
Rubber and plastic	-0.6	-1.1	-0.3	0.8	4.3	1.4	0.2	2.8
Textiles, apparel, and leather	2.9	0.0	0.1	2.8	2.5	1.7	0.2	0.6
Lumber and wood	1.5	1.3	0.3	0.0	0.2	0.5	0.2	-0.5
Furniture and fixtures	2.6	-1.4	-0.2	4.2	1.6	0.5	0.3	0.9
Paper and allied products	2.2	1.9	-0.2	0.5	-1.2	1.1	0.2	-2.4
Printing and publishing	0.4	0.1	0.0	0.3	-0.3	1.5	0.2	-2.0
Primary metal	2.8	0.2	-0.1	2.7	1.8	0.7	0.2	0.9
Fabricated metal	1.9	-1.0	0.0	2.9	1.4	0.6	0.3	0.5
Ind. mach. and elect. equipment	7.4	1.5	-0.4	6.3	16.9	2.3	0.4	14.2
Transportation equipment	3.7	1.8	-0.3	2.2	2.0	0.8	0.1	1.1
Non-metallic mineral products	3.0	-1.2	-0.1	4.3	1.3	1.3	0.3	-0.2
Chemicals and chemical products	3.9	-0.2	-0.1	4.1	2.3	1.9	0.2	0.2
Other manufacturing industries	1.0	-0.8	0.0	1.7	6.2	1.3	0.4	4.5
Transportation	1.7	0.8	0.3	0.6	1.7	0.9	0.2	0.5
Communications	3.3	2.7	2.0	-1.3	2.3	2.2	0.1	0.1
Utilities	3.3	-1.0	-0.2	4.5	4.0	2.6	0.1	1.4
Trade	3.0	0.8	0.6	1.6	5.4	1.7	0.1	3.6
FIRE	2.7	1.3	0.2	1.2	2.8	2.0	0.2	0.6
Other services	0.6	0.5	0.7	-0.7	0.0	1.0	0.3	-1.3
Total	1.8	0.8	0.3	0.9	2.6	1.5	0.2	1.1

Source: International Monetary Fund staff estimates.

estimates obtained by conducting growth accounting at an aggregate level (Macklem 2003).[17]

- In the post-1995 period, the labour productivity gap between the two countries widened not only in the ICT-producing sector, but also in sectors that intensively used ICT capital.[18] Canada's non-ICT-producing manufacturing industries appear to have performed as well as, if not better than, their US counterparts. However, a gap emerged in sectors that have been most intensively using new technologies, such as the trade and FIRE (financial, insurance, and real estate) sectors. In particular, labour productivity growth in Canada's trade sector was well below that in the United States, reflecting shortfalls in both TFP and capital deepening. A gap also opened in the FIRE sector, reflecting a smaller contribution of capital deepening than in the United States.

4.3 How did the free trade agreements affect productivity growth in Canada?

The persistence of the labour productivity gap in the face of the dramatic increase in trade linkages between Canada and the United States has puzzled many observers.[19] Recent studies in growth literature have highlighted a variety of mechanisms through which increased trade would affect productivity growth. In particular, trade would facilitate the transfer of knowledge, increase scale and specialization, and, by increasing exposure to competition, induce a reallocation of resources from less to more efficient firms within industries. At the same time, traditional trade theories, as embodied in a Heckscher-Ohlin framework, predict a reallocation of resources towards sectors where a country has comparative advantage. To the extent that Canada's comparative advantage lies in sectors less exposed to the dynamic gains from trade, such as the natural resource and resource-based manufacturing sectors, the inter-industry resource reallocation induced by trade may have hindered the productivity gap with the United States from closing (Jackson 2003a).

The fact that Canadian trade has increased mainly in two-way trade in similar products suggests that Canadian firms are likely to have benefited greatly from the dynamic gains of trade. To assess this hypothesis, average

17. Recent data revisions by Statistics Canada suggest that the aggregate labour productivity growth gap between Canada and the United States in the 1995–2000 period has been smaller, about 1/2 per cent, than what is suggested by the data used in this paper.

18. The ICT-producing sector is proxied by the industrial machinery and electrical and electronic product sectors.

19. See the exchange of ideas between McCallum (1999) and Jackson (1999) on the occasion of the 10th anniversary of NAFTA.

Canadian industry TFP growth is plotted against (i) the degree of vertical specialization, and (ii) the degree of trade exposure of Canadian sectors.[20] Figure 12 shows that the average TFP growth is positively correlated with both measures of openness to trade, and the extent of the correlation has increased since the inception of the free trade agreements with the United States. In particular, the ICT-producing and transportation equipment sectors seem to have benefited most from exposure to trade and intra-industry specialization over this period.

Moreover, the free trade agreements seem to have contributed to convergence in TFP between the two countries. To assess the impact of the agreements on the TFP convergence between Canada and the United States, an autoregressive model is estimated; it contains both industry and time-specific effects and a structural change in the autoregressive coefficient:[21]

$$TFP_{i,t}^{Can-US} = \beta TFP_{i,t-1}^{Can-US} + \gamma D_{CUSFTA}$$

$$+ \delta D_{CUSFTA} * TFP_{i,t-1}^{Can-US} + \alpha_i + \lambda_t + \varepsilon_{i,t}, \qquad (4)$$

where i is the index for industries ($i = 1 \ldots 23$), t is the index for time ($t = 1 \ldots 20$), $TFP_{i,t}^{Can-US}$ is the log-TFP differential between Canada and the United States for industry i derived from equation (2), and D_{CUSFTA} is a dummy that controls for the impact of CUSFTA (from 1990). Table 7 reports the results from the Arellano and Bond (1991) generalized method of moments (GMM) applied to equation (3) in first differences.[22] The estimated value of β is significantly less than 1, suggesting convergence in TFP levels between Canada and the United States over the period considered. Furthermore, the estimated negative value of δ (significant at a

20. The degree of vertical specialization measures the extent to which an industry's trade is accounted for by inputs that are imported and embodied in exports. The degree of trade exposure is the algebraic sum of three different indicators: (i) the share of an industry's exports in its gross output (capturing its degree of export orientation); (ii) the share of an industry's imported intermediate inputs in its gross output (capturing the exposure of an industry on the cost side); and (iii) the share of an industry's competing imports in the domestic markets for its core products (measuring the exposure to foreign penetration of the domestic market). Both indexes of openness to trade are from Dion (1999–2000). The data, originally up to 1996, have been extrapolated to 2000.

21. Easterly, Fiess, and Lederman (2003) adopt this methodology to assess the impact of NAFTA on the Mexico-US productivity convergence.

22. As is well known, the presence of a lagged dependent variable in a fixed-effect model generates biased ordinary least squares estimates. The Arellano-Bond technique allows to obtain unbiased and consistent estimates by moving to a specification in first differences and instrumenting the lagged changes of the dependent variables with its lagged ($t - 2$ and earlier) levels.

Figure 12a
Trade exposure and TFP growth

Average 1981–2000

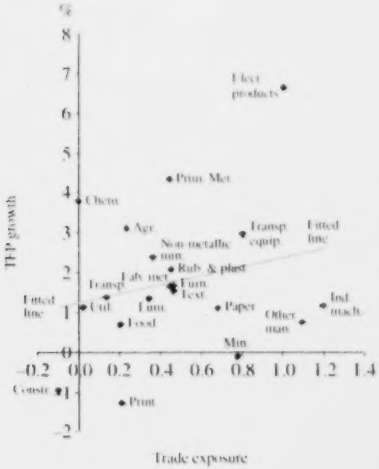


Figure 12b
Trade exposure and TFP growth

Average 1990–2000

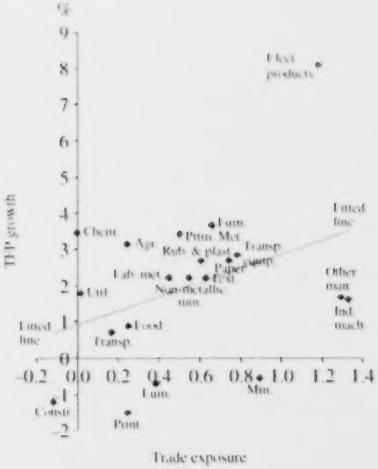


Figure 12c
Vertical integration and TFP growth

Average 1981–2000

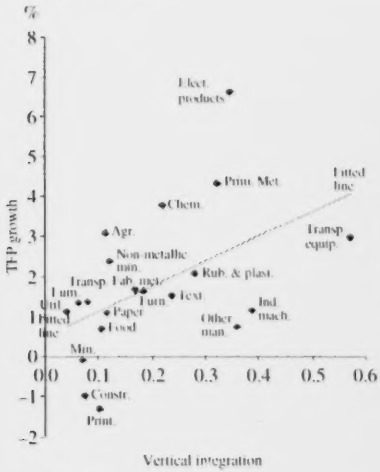


Figure 12d
Vertical integration and TFP growth

Average 1990–2000

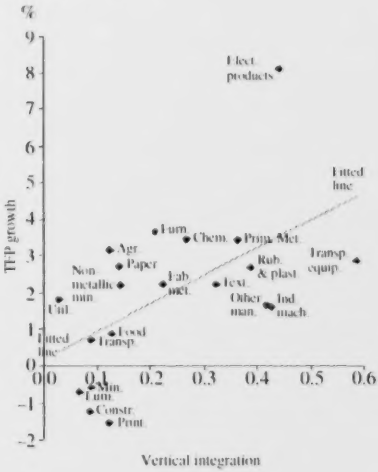


Table 7
Estimation of TFP convergence equation[a]

	All sectors	Manufacturing
$TFP^{Can/US}(-1)$	0.79	0.69
	(0.00)	(0.00)
$D_{CUSFTA} \cdot TFP^{Can/US}(-1)$	-0.06	-0.11
	(0.09)	(0.14)
D_{CUSFTA}	-0.04	-0.06
	(0.00)	(0.00)
No. of observations	414	252
Sargan test (*p*-value)	0.74	0.34
AR(2) test (*p*-value)	0.59	0.21

Notes:
a. Dependent variable: log-TFP differential (Canada minus United States).
Yearly data, covering 23 industries for the period 1982–2000.
Year dummies are not reported. Numbers in parentheses are *p*-values, based on heteroscedastic robust standard errors.

10 per cent level) indicates that the rate of convergence has increased in the 1990s after the Canada-US free trade agreement. The role of trade is confirmed by the fact that convergence has been even faster in the manufacturing sector, as shown by the lower coefficients in the second column.

These results are consistent with those of other papers about the impact on productivity of increased trade linkages between Canada and the United States. For example, examining the impact of CUSFTA on productivity in the manufacturing sector, Sawchuk and Trefler (2002) find that, over the 1989–95 period, tariff cuts raised labour productivity by 3.25 per cent per year in the most affected industries, and by 0.5 per cent per year in the overall manufacturing sector. On the other hand, empirical research has failed to identify a positive link between trade specialization and TFP growth in Canada (Harris and Kherfi 2000) and noticed that the specialization of Canada's manufacturing sector has hardly changed under the free trade agreement (Head and Reis 2003).

4.4 The impact of industrial structure on the aggregate labour productivity gap

The evidence thus far suggests that factors other than trade linkages with the United States have likely been at work in driving the Canada-US labour productivity gap. Conducting growth accounting at a sectoral level allows for quantifying the role played by the differences in industrial structures between the two economies. This is done by decomposing the aggregate

labour productivity growth gap between Canada and the United States into three components, which correspond to the three terms on the right-hand side of equation (5):

- a "direct" effect, which reflects the contribution from industry i's different labour productivity growth performance, weighted by its average value-added share (va_i);
- a "structural" effect, which reflects the contribution from the industry i's different relative size across the two countries, weighted by its average labour productivity growth;
- and a "reallocation factor," which reflects the different ability of the two economies to direct labour resources (hours worked, h_i) towards sectors with a value-added share that exceeds the labour compensation share (ls_i) (that is, towards sectors with a higher-than-average labour productivity level);[23]

$$\begin{aligned}\dot{y}_{Can} - \dot{y}_{US} = & \sum_i \left(\frac{va_{i,Can} + va_{i,US}}{2} \right) (\dot{y}_{i,Can} - \dot{y}_{i,US}) \\ & + \sum_i \left(\frac{\dot{y}_{i,Can} + \dot{y}_{i,US}}{2} \right) (va_{i,Can} - va_{i,US}) \\ & + \left[\sum_i (va_{i,Can} - ls_{i,Can}) \dot{h}_{i,Can} \right. \\ & \left. - \sum_i (va_{i,US} - ls_{i,US}) \dot{h}_{i,US} \right]. \end{aligned} \tag{5}$$

This decomposition shows that a significant part of the widening labour productivity gap between Canada and the United States over the post-1995 period is explained by structural differences between the two economies. Table 8 shows that the negative contribution from the "direct" effect has increased slightly over the two periods, whereas the other two effects nave

23. See Faruqui et al. (2003) for a similar decomposition formula. Their conclusion is that most of the business sector labour productivity growth gap between Canada and the United States in the 1987–2000 period is explained by the direct effect. Moreover, the manufacturing sector is the main contributor to the aggregate gap in the post-1996 period, while the service sector is more relevant in the period 1987–96. However, these results are obtained at a rather coarse level of disaggregation (four large sectors are identified, namely, primary, manufacturing, construction, and services), something that (as admitted by the same authors) might conceal the contribution from the structural and reallocation effects.

Table 8
Canada-US labour productivity growth gap
(Percentage)

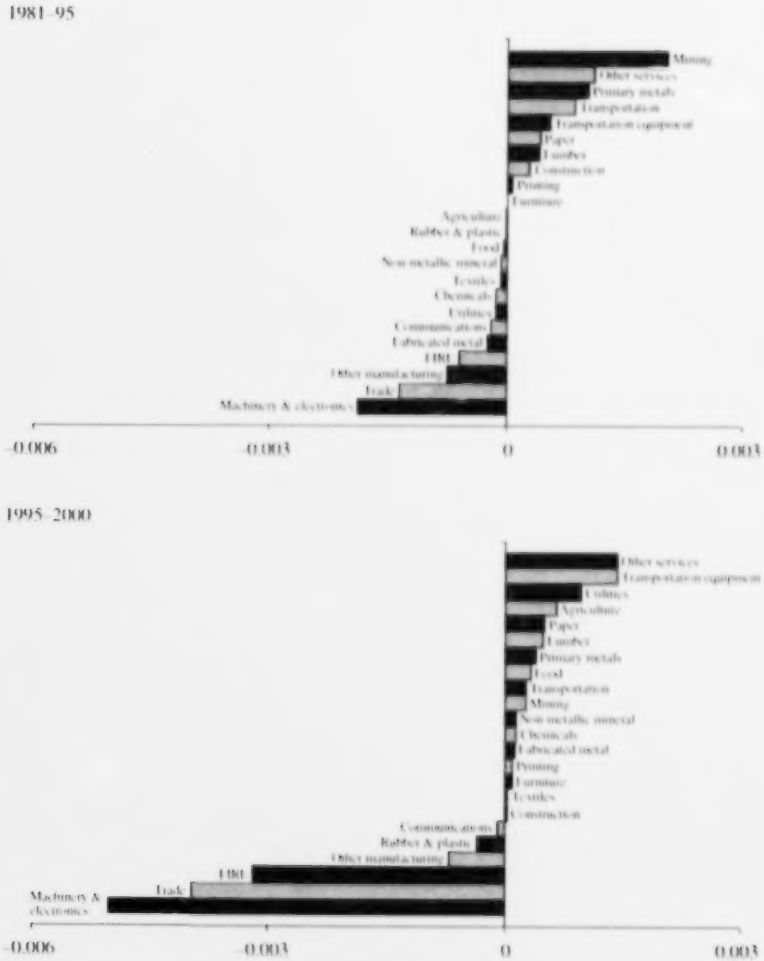
Contribution from:	1982–2000	1982–95	1995–2000
Direct effect	-0.2	-0.1	-0.2
of which:			
Industrial machinery and electrical and electronic equipment	-0.1	-0.1	-0.2
Transportation equipment	0.1	0.0	0.1
Other manufacturing industries	0.0	0.0	-0.1
Communications	0.0	0.0	0.0
Utilities	-0.1	0.0	0.0
Trade	-0.2	0.0	-0.4
FIRE	0.1	-0.1	0.0
Other services	0.0	0.0	0.1
Structure effect	0.0	0.1	-0.2
Reallocation effect	0.0	0.1	-0.2

Source: International Monetary Fund staff estimates.

become a negative contributor in the post-1995 period. This seems to suggest that the widening of the Canada-US labour productivity gap over the second half of the 1990s was mostly due to a shift in the relative pattern of industry specialization. In other words, rather than having become less productive than the United States, Canada has tended to be less successful in directing resources towards high-productivity sectors.

The widening of the aggregate labour productivity gap between Canada and the United States over the second half of the 1990s has been driven mainly by the ICT-producing sector and two major service sectors, trade and FIRE. Figure 13 shows the industries' contribution to the aggregate labour productivity growth gap in the two subperiods, 1981–95 and 1995–2000. Each industry's contribution is given by the sum of its contribution to the "direct," "structure," and "reallocation" effects. While the ICT-producing sector has remained the major contributor to the aggregate gap over the whole period, the negative contribution from the trade and FIRE sectors rose significantly in the second half of the 1990s. The negative contribution from the ICT-producing manufacturing and trade sectors mainly reflected lower labour productivity growth, whereas the negative contribution from the

Figure 13
Sectoral contributions to the Canada-US aggregate labour productivity growth gap
(Percentage)



FIRE sector was largely the result of the lower relative size of the sector in Canada.[24]

Conclusion

The results above illustrate that while free trade has helped promote the integration of the US and Canadian economies, significant differences remain. Business cycles in Canada and the United States have certainly become more synchronized, and the importance of common factors in explaining business cycles in the two countries has increased, likely reflecting the significant increase in trade based on vertical specialization. Nonetheless, significant structural differences between the two economies remain evident. Primary goods still account for more than 30 per cent of Canada's total exports, and the analysis above shows that country-specific and idiosyncratic factors remain very important in explaining the Canadian business cycle.

The continued importance of country-specific and idiosyncratic factors in driving business cycles in Canada also confirms the benefits of exchange rate flexibility. Although there remain those in Canada who argue in favour of a Canada-US monetary union, the significant differences in industrial structure and composition of trade between the two countries suggest that there could be important costs to Canada from giving up its ability to insulate itself from country-specific and other shocks.

The paper also shows that the widening labour productivity gap between the two economies over the 1990s is a reflection of the differences in the industrial structure of the two countries. Industry growth accounting shows that Canada has done as well, if not better, than the United States in many (non–ICT-producing) manufacturing sectors, while it has lagged in some industries that have been intensively using ICT capital, especially in the service sector. In this paper, the industries' contribution to the aggregate labour productivity gap is weighted through their relative value-added shares, and it also reflects the economy's ability to reallocate resources from less productive to more productive sectors. From this perspective, the United States has been able to take a much larger benefit from the dramatic

24. The comparison between the trade sectors in the two countries may be blurred by the fact that eating and drinking places are included in the US trade sector, while they are part of the "other service" sector for Canada (as they are in the "accommodation, food, and beverage" sector). However, the results do not change substantially when the Canadian trade sector is adjusted to include that fraction of the "accommodation, food, and beverage" sector that can be attributed to eating and drinking places.

acceleration of labour productivity growth in the service sectors, owing to the larger share of these sectors in their economy compared to Canada.

The negative impact from the difference in industry specialization between the two countries does not seem to be related to the increased trade integration of Canada over the 1990s. Much of the increased trade occurred within industries, as shown by the increased degree of vertical specialization of many Canadian sectors (in particular, transport equipment and ICT-producing sectors). This has allowed Canadian firms to benefit from economies of scale and technology transfers, which appear to have contributed positively to their TFP performance over the past decades.

These findings suggest that there could be gains from further steps to deepen economic linkages. The CUSFTA/NAFTA experience illustrates the significant benefits accruing to both countries from free trade, but important barriers remain. For example, differences in regulatory frameworks impede trade and investment flows; security concerns, which have become critically important during the past two years, slow cross-border flows of goods; and rules-of-origin requirements also restrict trade flows (McMahon, Curtis, and Adegoke 2003). Recent research suggests that the removal of rules-of-origin requirements and the harmonization of most favoured nation (MFN) tariffs—which is under discussion among the NAFTA partners—could boost NAFTA's GDP by as much as 2 to 3 per cent (Policy Research Initiative 2003).[25]

25. NAFTA partners have recently decided to establish study groups to analyze avenues for harmonization of MFN tariffs and rules-of-origin requirements, and to improve rules governing investment flows. In addition, recognizing the importance of secure and continuous access to each other's markets, Canada and the United States have recently placed an emphasis on border security. For example, a Smart Border Action Plan has been implemented, which includes a Free and Secure Trade (FAST) program to harmonize procedures for clearing cross-border shipments. For an extensive discussion of the impact of rules-of-origin requirements, see Estevadeordal and Suominen (2004). Mirus and Hoffman (2004) and Ghosh and Rao (2004) argue that there are large gains associated with the harmonization of MFN tariffs and the liberalization of NAFTA's rules of origin.

Appendix 1
Data Sources

Data for Canada

Real (chain-Fisher-weighted) value added, hours worked, labour input, and capital services data were obtained from Statistics Canada and were based on a SIC-80 industry classification.

For the manufacturing sectors, however, the data ended in 1997. They were extrapolated to 2000 using the growth rates from the KLEMS input and output database, which follows the North American Industry Classification System (starting from 1997).

Comparing the 1997 industries' value added based on the two industry classifications shows that the difference is generally around 15 per cent, except for "other manufacturing sector" and "furniture and fixture," for which the difference is around 30 per cent. The results for these sectors should then be interpreted with greater caution than others.

Data for the United States

Industry data for the United States follow the US SIC-87 industry classification.

Real (chain-Fisher-weighted) value-added industry data for the United States were obtained from Bureau of Economic Analysis's "gross product originating" (GPO) by industry. As these figures are on a market-price basis, value-added data at basic prices were obtained by subtracting the indirect business tax and non-tax liability from GPO.

GDP by industry is obtained from industries' components of domestic income which, as is well known, tend to fall short of GDP measured on an expenditure basis. The difference is named "statistical discrepancy," and is attributed to the industries based on their share of total GDP.

Hours worked, labour input, and capital services were obtained from Jorgenson, Ho, and Stiroh (2005) and are based on methodologies that are largely comparable with those adopted by Statistics Canada.

Industry classification

To obtain the same level of industry classification for the two countries, a number of subsectors were aggregated into larger sectors. As an example, a "mining" sector was obtained for the United States by aggregating four subsectors (namely, metal mining, coal mining, petroleum and gas, and non-metallic mining).

The aggregation was also needed to obtain comparable sectors for the two countries. For example, US SIC-87 classification places computers and office equipment in "industrial machinery," while Canada SIC-80 classification places it in the "electrical and electronic" equipment. For comparison, the two sectors were aggregated into one large sector, which was taken as a proxy for the ICT-producing sector in the paper.

The following aggregation criteria were used: subindustries value added were aggregated using value-added shares as weights; labour and capital inputs were aggregated using relative shares in aggregate labour compensation and capital income, respectively, as weights; and hours worked were aggregated through the unweighted sum.

Despite following these aggregation procedures to obtain reasonably comparable sectors for the two countries, minor differences still persist, particularly in the service sectors. In addition to the different treatment of eating and drinking places (see footnote 24 in the main text), another difference that is worth mentioning relates to postal services, which are placed in the "communications" sector for Canada but in the "transportation" sector for the United States.

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Discussion

Eva Ortega

This paper offers an extensive and comprehensive review of real macroeconomic links between Canada and the United States. It discusses the foundations of the debate on whether or not the trade agreements between the two countries in the past decades have been beneficial for Canada, in particular for the dynamics of its business cycle and productivity.

My interpretation of the paper's main points is the following. First, trade with the United States accelerated in Canada since the Canada-United States Free Trade Agreement (CUSFTA) at both the national and regional levels. This acceleration was especially evident in the manufacturing sector, which increased cross-border vertical integration. Second, the higher business cycle synchronicity observed over time between Canada and the United States may not necessarily be due to trade intensification. Cardarelli and Kose find that the biggest source of Canadian business cycle fluctuations are idiosyncratic factors, which contribute strongly to the case for flexible exchange rates. Third, the widened gap of labour productivity between the United States and Canada since the mid-1990s is shown to be linked to poorer performance of the information and communication technologies (ICT) sector in Canada. Trade intensification indeed reduced the total factor productivity (TFP) differential across countries but did not bring about convergence.

I will focus on three aspects of the paper: (i) the measurement and interpretation of business cycle synchronicity; (ii) the evidence and conclusions on the productivity gap; and (iii) whether Canada-US real macroeconomic links represent a story of trade.

Business Cycle Synchronicity

As highlighted by the authors, evidence of higher trade and vertical specialization would result in a more common business cycle. However, section 4 of their paper shows evidence of different production structures in Canada and the United States, which would cause more country-specific cyclical fluctuations. Which effect dominates is unclear, both theoretically and empirically. The authors choose a dynamic factor model for output, consumption, and investment in Canada and the G-3 and find that idiosyncratic factors are the main source of the business cycle fluctuations of Canadian variables.

A frequent criticism of factor models is that they do not provide a clear economic interpretation of the various factors. The authors' Table 4 shows the variance decomposition[1] results and finds that for the United States, the dominant role of the country-specific factor in the 1960s and 1970s is replaced by that of the common factor in the past two decades. How do we interpret the common factor in this case? Did the United States become the common factor for the G-3 and Canada business cycles in the past two decades? If so, the higher role that the paper finds for the common factor in Canadian fluctuations in the 1980s and 1990s could then be interpreted as a deeper economic integration with the United States.

On a different note, this higher significance of common fluctuations found in the latter period (1981–2002) is compatible with the maintained or increased role for country-specific or idiosyncratic fluctuations and has been highlighted elsewhere (see, for example, Canova, Ciccarelli, and Ortega 2004). The main reason behind both findings is that macroeconomic fluctuations were less volatile in the G-7 countries in recent periods, especially during the 1990s. Lower volatility causes less uncertainty around estimated common cycles as well as country-specific cycles, which were often non-significant before the 1990s because of wide standard errors. Determining whether the recent lower business cycle volatility is due to increased integration or to other causes, for example, smaller shocks, would require a structural model rather than a reduced-form model like the one in this paper.

1. The variance decomposition is shown for two periods (1960–81 and 1981–2002), and the coefficients are kept fixed. Since the break is not linked to a particular change in trade agreements, differences across subperiods cannot, unfortunately, be linked to trade intensification.

The Canada-US Productivity Gap

The authors show how the convergence of Canadian per capita income with that of the United States has been held back since the mid-1990s as a result of the widening of the gap in labour productivity. The common explanation for this indicates a smaller and less productive ICT sector in Canada, together with a lower ICT capital deepening in Canadian firms. Cardarelli and Kose use industry data to look for possible sectoral dynamics behind the gap and for a possible link with trade intensity. This is an ambitious and demanding task.

The accounting exercise for growth in sectoral labour productivity yields an estimate of –0.8 per cent for the Canada-US labour productivity gap in the 1995–2000 period versus 0.9 per cent in 1982–95. The contributing factors found for that change confirm the consensus story above and are: (i) the significantly smaller TFP growth in the ICT sector in Canada, despite the reduction of the Canada-US TFP gap in general; and (ii) the far lower capital deepening in Canada than earlier.

The results for the 1995–2000 period should be considered with caution, since the authors extrapolate the database for manufactures after 1997 using a different industry definition. Indeed, the authors acknowledge that recent estimates show a Canada-US labour productivity gap in 1995–2000 of around –0.4 per cent.

A volume edited by Dale Jorgenson examines this productivity gap, using the new KLEMS (capital, labour, energy, material, and service) database. In this publication, Ho, Rao, and Tang (2004) find that FIRE (financial, insurance, and real estate services) and retail trade, followed by communications, agriculture, and other services, contributed most to aggregate labour productivity growth in Canada in 1995–2000. More productive ICT-producing industries contributed less because of their small size. Consistent with this new evidence, Cardarelli and Kose report an important contribution of services to the productivity gap in 1995–2000, which they find is not so much due to big differences in productivity but rather to the fact that rapidly improving sectors, such as the FIRE services, are larger in the United States (the "structure effect").

The authors also analyze the effect of trade agreements on productivity. Informal evidence is found of higher TFP growth in Canada after CUSFTA, linked to greater vertical specialization and trade exposure. In terms of the Canada-US gap, the authors find that trade intensification reduced the TFP

level differential,[2] although it did not lead to convergence. It would have been interesting to see an analysis related to the labour productivity gap or even to TFP growth.

Cardarelli and Kose conclude by arguing that the main reason behind the increased gap in labour productivity growth between Canada and the United States is the reallocation and industry structure differences; that Canada has been less successful in redirecting resources to sectors of high productivity. However promising, their analysis could be extended by reporting, for example, the size of the reallocation factor for each country. It may also be worth exploring the reallocation effect using other sectoral information, such as capital reallocation and the entry and exit of firms from high-productivity sectors. But is this reallocation effect linked to higher trade intensity or is it linked to different investment patterns in the two countries?

A Story of Trade?

Trade agreements between Canada and the United States do not seem to have clearly affected either the business cycle synchronicity or the evolution of productivity growth in the two countries. Thus, have Canada-US real macroeconomic links been governed by trade? Or are they determined more importantly by their differing economic structures or by aggregate and sectoral investment patterns?

If the different structures or investment behaviour matter most, then perhaps domestic policies rather than international trade agreements should be emphasized and encouraged.

The extensive information conveyed in Cardarelli and Kose's work provides challenging evidence that stimulates interesting and important further investigation. Their Table 5, for example, reports a remarkably slower growth of the use of ICT capital services by Canadian firms than by their US counterparts. What can explain this difference?

2. The TFP gap is calculated assuming equal input shares across countries. This assumption leads to erroneously interpreting the cross-country differences in input income shares in value added as TFP differential.

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General Discussion*

Graham Voss, in response to comments, pointed out that his results seemed conclusive, but that more work should be done to try to reconcile the lack of a border effect according to the sectoral data in his paper and the strong Canadian component that was found in the Gosselin et al. paper. In response to Ortega's comments, Ayhan Kose made four points. First, while using fixed coefficients over the two sample periods was debatable, their paper was not trying to link the cyclical convergence with trade agreements. Going forward, rolling regressions and structural break tests may be useful in this context. Second, the common factor is not the US economic cycle. The output data are not weighted and the United States is not the main driver of the common factor. Third, neither is decreasing volatility of shocks. Fourth, given the fact that data revisions have tended to lessen the Canada-US productivity gap in recent years, measurement of productivity across countries remains a challenge.

In the general discussion that followed, Raphael Solomon asked Kose if it was not too soon to evaluate the effects of NAFTA, given that tariffs were to be phased out over time, up to ten years for certain categories of goods. Kose agreed it would be useful to look at this again in 2010. Gregor Smith asked if researchers could provide confidence intervals, since observed differences across different time periods might not be statistically significant. Moreover, shock decompositions can be interpreted for exogenous variables, but not for endogenous variables, as reported in the papers. Kose replied that confidence intervals can be found in the paper. Nicholas Rowe cautioned against using correlations evidence to assess optimal currency areas. For

* Prepared by Robert Lafrance.

instance, if the Bank of Canada could perfectly offset the common Canadian shock in these models, then we would conclude that Canada was not an optimal currency area (since only the international and regional shocks would be in evidence). What the correlations show is the failures of central banks to offset shocks. Kose agreed, but noted that a flexible exchange rate regime is still valuable for Canada despite its growing integration into the US economy.

Policy Panel: Canada's Role in International Macroeconomic Policy

Discussion 1

Mark Carney

I would like to draw on my recent experience on both the Finance and Bank sides of the G-7 process to provide some perspective on Canada's role in international macroeconomic policy.

I will begin by outlining the G-7's priorities in recent years. It may surprise you—it surprised me—that G-7 finance ministers and their deputies spend more than half of their time on development issues. There are advanced, ongoing, and complex discussions on debt relief for heavily indebted poor countries (HIPCs), mechanisms for leveraging and front-loading aid, and priorities for implementing codes and standards in emerging markets. The priorities of the UK chair for next year are development and Africa. International macroeconomic challenges, of which there are several, come further down the list.

The G-7 is principally a talk shop, particularly for central bankers. At its best, it provides a forum for frank discussion, improved mutual understanding, and relationship building. These elements can be decisive in improving macro-policy management and averting and/or managing crises.

A more proactive role for the G-7 is its control of the International Monetary Fund (IMF) and the World Bank. At a minimum, the G-7 has effective negative control in that it can block virtually any initiative or program it wishes (in fact, the United States alone virtually has this negative control). I would argue that, for good or ill, the G-7 also has positive control over most of what is accomplished by the international financial institutions (IFIs). The G-7 sets the agenda and defines the parameters of the debate.

With that backdrop, international macroeconomic issues are discussed in three settings:

(i) broad IFI issues, including reform of the international financial architecture and individual country programs that are regarded as potentially systemically important;

(ii) current conjectural "crises," including exchange rates and oil prices;

(iii) increased attention to structural resolution of global imbalances under the rubric of the agenda for growth.

In saying a few words about each, I will try to illustrate the role for Canada.

Canada, particularly the Bank of Canada, has been very active in developing the agenda to reform the international financial architecture. Canada has played leading roles in the development of the Exceptional Access Policy, more sophisticated applications of the Balance Sheet Approach, and now efforts to modernize the management and risk management of the IMF. In these examples, the over-used Keynes quotation about "madmen in authority"[1] is applicable. Madmen may run the IMF (see my comment about G-7 finance officials' control above), but it is the thoughtful leadership of the Bank of Canada that trickles down to guide reform efforts and bring some sanity to global financial management.

In this regard, it should be noted that we enjoy the benefits of a very strong IMF office, which represents a constituency of nations, including some heavy users of IMF and Bank programs. This provides a unique perspective.

An important aspect of this work has been the Bank's ability to build partnerships with other institutions, most notably the Bank of England, with whom the Bank of Canada has enjoyed a long and productive research program, but also the Bundesbank and the Banque de France. Another encouraging development has been the Bank's outreach to major emerging markets, such as Mexico and Argentina, to share its expertise in inflation targeting and financial stability management.

Over the course of the past 18 months, increased volatility in exchange rates and oil prices has naturally garnered increased attention at the G-7. In these discussions, Canada has consistently stressed the importance of letting the markets work and of governments pursuing sound macro policies. In many respects, Canada provides a purity of perspective in exchange rate issues

1. "Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back." From *The General Theory of Employment, Interest and Money*, 1936, John Maynard Keynes.

that is often lacking. While we have long recognized the benefits of flexibility, it should not be underestimated how often this needs to be repeated, even among the most nominally sophisticated audiences. At times of heightened volatility, there is tremendous political pressure to do something. This pressure is not lessened by the fact that asset markets may overshoot on occasion. The least harmful outgrowths are efforts for greater accuracy in oil-market statistics (see Fall 2004 G-7 meetings) and that carefully crafted language on exchange rates in G-7 communiqués.

In fact, the language from the February 2004 G-7 meeting in Boca Raton is entirely consistent with our exchange rate policy:

> We reaffirm that exchange rates should reflect economic fundamentals. Excess volatility and disorderly movements in exchange rates are undesirable for economic growth. We continue to monitor exchange markets closely and cooperate as appropriate. In this context, we emphasize that more flexibility in exchange rates is desirable for major countries or economic areas that lack such flexibility to promote smooth and widespread adjustments in the international financial system, based on market mechanisms.

Over the course of the past year, the G-7 discussions have focused increasingly on the Agenda for Growth. The agenda serves several purposes: first, depending on your perspective, it is either a bully pulpit against or a welcome push for Europe; second, it is a way to share best practices; and third, it is a component of the multi-faceted process for adjusting to global imbalances.

In discussions on the Agenda for Growth, Canada usually begins by underscoring the importance of sound macro policies. In this regard, we have an exemplary record among our G-7 peers:

- seven straight surpluses;
- lowest general government debt to GDP;
- lowest foreign debt burden;
- highest growth in living standards;
- highest cumulative income growth;
- second highest per capita income;
- highest employment growth;
- highest (absolute highest) employment ratio;
- and the only public pension that is actuarially sound for 50 years.

Of course, our challenge is both to maintain this record (no easy task) and to accelerate the agenda for microeconomic reform. There is a need for progress on a range of issues, including improved labour market flexibility, deepening the Canadian economic union, and improving financial market efficiency. The downside to our remarkable employment performance in recent years is that there is, by definition, less un- and under-employed labour to crowd in, which when combined with our demographics, means that we will need to rely more heavily on capital deepening and total factor productivity to maintain our potential growth rate.

One of the principal challenges for the G-7 is its ongoing relevance in light of the increased importance of China and other major emerging markets. Thus far, the G-7 has responded to these welcome developments by increased engagement with China, with whom we meet regularly at various levels. Clearly, Asia holds the key to the smooth resolution of global imbalances and the increased flexibility of the global economy. Our challenge is to engage China while maintaining the like-mindedness characteristic of the group, including the agenda for development that is so central to the G-7's activities.

Discussion 2

John F. Helliwell

I have found this a very interesting conference, full of useful research and relevant discussion. Most of the papers are focused, and rightly so, on establishing the nature and consequences of international transmission mechanisms. In this closing panel, there is both opportunity and obligation to take a broader view. We can now ask, in the light of what has been learned from the conference, what can be done to increase the efficiency and stability of the international system. Are there policy vacuums that need to be filled? If so, by whom? In particular, where are the gaps that could or should be filled by Canadian actions and advocacy? To set the stage for this, I should summarize my empirical assessment of the structure and risks of the current international system, and make a case for re-balancing the criteria used to judge the results of national and international economic policies.

As confirmed by several important new empirical papers prepared for this conference, the structure of economies and societies, even after a half century of trade growing faster than GDP, is still predominantly local, regional, and national. Thus it is that study after study finds that market integration assumptions are rejected by international data while being accepted by comparable intranational data. This led me earlier (Helliwell 2002, 24) to conclude that the only thing wrong with most of the theory of international trade and finance is the word "international." Thus did Davis et al. (1997) find the working of the factor abundance theory supported by trade among Japanese prefectures while being rejected by international data. Similarly, Andrew Rose (this volume), finds that a necessary condition for stock market integration is passed for the New York Stock Exchange (NYSE)

on its own and for the Toronto Stock Exchange (TSX), but strongly rejected as between the two national markets. And this is comparing two markets, as noted by Eric Santor (this volume), with a very large number of cross listings (of TSX shares on the NYSE), probably more than for any other pair of national stock exchanges.

Similarly, Jean Imbs (this volume) finds that intranational capital markets appear to provide evidence consistent with intertemporal consumption smoothing, while the reverse is always found to be the case when international data are used. This finding is of course no surprise, as the Imbs estimation form has strong parallels with those underlying tests of the Feldstein-Horioka (1980) puzzle, although the latter literature gives more importance to the relation between national saving and domestic investment (as recommended at this conference by Gregor Smith, in his commentary in session 3), rather than to consumption smoothing. Subsequent tests of the Feldstein-Horioka equation combining intranational and international data have established that the strikingly large correlation between savings and investment rates at the national level is entirely absent among Canadian provinces (Helliwell and McKitrick 1999). And, to answer Linda Goldberg's query about the possibly confounding effect of equalization and other transfer payments, this result holds whether or not federal-provincial transfer payments are netted out (Helliwell and McKitrick 1998, 7).

Charles Engel (this volume), using a new set of price-level data for US and Canadian cities, continues to find, as he and John Rogers found in their pioneering work (Engel and Rogers 1996), that prices are much more closely linked among cities in the same country than they are between cities in different countries. In his new work making use of price levels rather than price changes, Engel is tempted to measure US-Canada cross-border market integration in terms of smaller absolute differences between price levels in the two countries. However, he finds instead large relative price cycles that are linked to changes in the nominal exchange rate. He interprets these as evidence of price setting that is sticky in local currency. That is surely part of the story, but it reflects also that the degree of market separation is far greater across national borders than across space, even given the strikingly large spatial separation of markets. The price-separating role of the border is also confirmed by the conference paper of Helliwell et al. (this volume), who test and strongly reject purchasing-power parity in the context of short-term determination of the bilateral Canadian exchange rate with the US dollar.

In this context, it is no surprise that the conference papers on business cycles by Gosselin at al. (this volume) and Cardarelli and Kose (this volume) continue to find robust regional and national components of business cycles

in both Canada and the United States. Nor is it surprising that Bouakez and Kano (this volume) find that the intertemporal present-value model, which assumes perfect market assumptions to be applicable to international data, is strongly rejected by Canadian current account data.

Thus, the conference papers have added to the already large quantity of evidence attesting to the distinctness of national markets, even within regional trade blocs as strong as those of the North American Free Trade Agreement and the European Union. The policy implications of this I shall emphasize later. When I do, I shall take as read the arguments I made earlier in Helliwell (2002) that the high levels of income, productivity, and well-being in smaller countries suggest that the separation of national economies is more likely to reflect efficient allocation than the existence of costly impediments to trade. As Charles Engel pointed out in his intervention in the first session, market separation does not imply an inefficient lack of integration, since tastes, preferences, and opportunities may vary systematically among countries, in ways that make local products optimal for local purchasers. I would add that where information is costly, where trust linkages grow weaker when distance and borders intervene, where tastes for variety are limited, and where local products are more likely to be designed to meet local tastes, efficient least-cost production and distribution are likely to be characterized by predominant matching of local products to local markets.

If the current levels of international market segmentation among the Organisation for Economic Co-operation and Development (OECD) countries were on balance a costly proposition, then the smaller OECD countries, which have proportionately much larger border effects (Anderson and van Wincoop 2003), would have lower values of GDP per capita (to the extent that there were efficiency costs) or lower life satisfaction (to the extent that consumers in small countries felt a lack of sufficient product variety). But, as is well known, the highest levels of life satisfaction are found in the smaller countries of Scandinavia and Western Europe. The emerging literature on subjective well-being (SWB) suggests that the especially high levels of SWB in these countries are due in large measure to the quality of their governments and to their high levels of mutual trust and engagement (Helliwell 2003). This provides a suitable transition to the second main feature of the empirical background: the importance of institutions for the establishment and maintenance of economic progress and broader measures of well-being.

The conference paper that speaks most directly to this second set of issues is that of Desroches, Francis, and Painchaud (this volume) on the structure and

pace of trade and growth in China and India. The main focus of their paper is on the importance of institutions, and their special contribution is to find an interaction effect between openness and institutional quality, with openness making no net contribution to growth in the absence of sufficient institutional quality. The authors are rather apologetic about the failure of the openness variable to have a positive effect on its own. By contrast, the institutional variable has positive effects both on its own and in combination with openness. Students of post-1991 economic shrinkage in the countries of Eastern Europe and the Former Soviet Union (FSU) should not be surprised one bit by this combination of results. Post-1991 research has shown that openness may be counterproductive in an institutional vacuum, since the Mafia and other bottom-feeders thrive in such an environment. When they move in, a bad situation becomes worse, and the eventual establishment of trust and the rule of law becomes a longer and tougher process.

Not all institutions matter equally for growth, and some are more likely than others to interact with openness. Whatever model is developed must be able to explain why China has been able to combine greater openness (at least in the trade-based measure of Desroches, Francis, and Painchaud) with high levels of growth, while the countries of the FSU have not. After all, GDP per capita in China doubled in the dozen years after the fall of the Berlin Wall, just as it was falling by half in Russia. How did China achieve this with such low levels of institutional quality, as measured by Desroches, Francis, and Painchaud?

It has been suggested that the interaction between institutions and growth may depend on the nature of the underlying cultural and national norms. Thus, it has been found that democracy and growth are negatively related in Asia, while positively related in Africa and Latin America, with the rationale being that both democratic and non-democratic leaderships in Asia are more concerned with growth and less with internal conflicts. Similarly, even though convergence was not general among the Asian economies, it was evident among those that were the most open (Helliwell 1993).

Both of these bits of evidence suggest that the more successful Asian countries have been able to achieve controlled openness, such that they were not overwhelmed during the process. The Asian crisis of the late 1990s perhaps provides a recent example where capital account openness had become unproductively great relative to the sophistication, trust, and mutual understanding required by lenders and borrowers alike. The most important advantage of such failed or costly experiments is to enable the relevant lessons to be learned. In the case of the management of openness, these lessons are being learned, but the learning process is still shackled by the

pressures imposed by ideological preconceptions. If one starts with an unquestioning belief that democracy and openness are good always and everywhere, then one is likely to be insufficiently able to receive and process the results of the many practical experiences taking place in real time. The same is equally true for those starting with an unshakable view that openness destroys national cultures, robs national capacities, and fuels exploitation. The need for evidence-based policy making was never greater, and it is especially important and difficult to establish when institutional design is at stake. This is partly because the evidence is harder to assemble and interpret, but mostly because of the ideological content implicit in the design and choice of market and political institutions.

The existence of high-quality institutions has been shown, by the Desroches, Francis, and Painchaud paper, to be an essential precondition for increases in economic openness to have positive effects on economic growth. When considering what defines high-quality institutions, it is important to remember that different arrangements work in different settings, and that one-size-fits-all is as wrong for institutions as for shoes. This, in turn, implies that if countries like Canada are to contribute to the global economy, one way will be through helping other countries to improve their own institutions. I shall return to consider this in more specific terms.

First, it is necessary to make a case for broadening the criteria used for measuring the success of economic and social policies. Using subjective well-being rather than GDP per capita as a measure of human welfare represents a major change in focus (as argued by several researchers in Kahneman, Diener, and Schwarz 1999), since country rankings are quite different for the two measures, and the policies indicated to improve them are often quite different. Economists have always assumed that utility should be the focus of attention, and it was only the absence of easily available measures of utility that caused researchers and policy-makers to place so much attention on the level and distribution of economic output, incomes, and consumption. While much recent research has emphasized the importance of high-quality government to economic growth, the quality of government is even more tightly linked to well-being. Indeed, attempts to explain international differences in life satisfaction have found that the strong simple correlation between per capita income and life satisfaction is greatly reduced or even eliminated when explicit measures of the quality of government are introduced into the equation explaining international differences in subjective well-being (Helliwell 2003).

Some economists have been skeptical of using subjective measures of life satisfaction, primarily because of their subjectivity. Presumably, for such economists, preferences need to be evidenced by deeds rather than merely

by expressed opinions. This skepticism underlay the question I was often asked in seminars where I presented research results based on well-being data: "If the Swedes are so happy, why do they commit suicide so often?" This led me eventually to the study of international differences in suicide behaviour, using the same countries and models I had used for the study of life satisfaction.

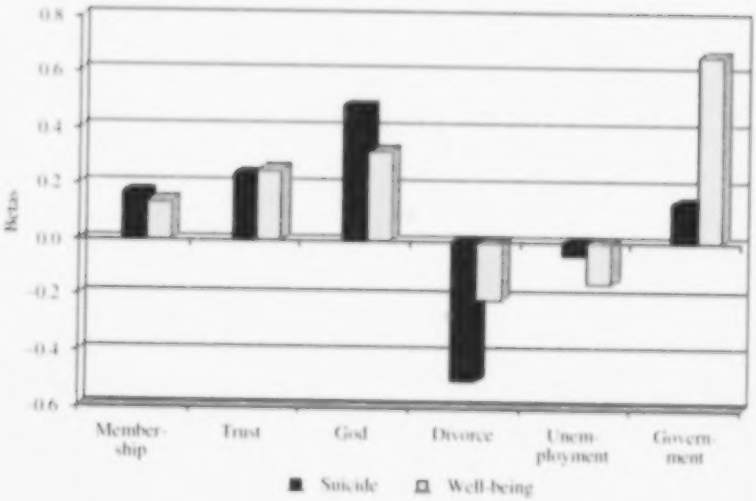
To a surprising extent, as shown in Figure 1 (adapted from Helliwell (2004)), the same model fits well-being and suicide remarkably well, with all coefficients having consistent signs. The signs are naturally opposite for suicide and well-being, since suicide is a consequence of extremely low life satisfaction. The suicide coefficients (expressed in standardized form) have been multiplied by −1 in Figure 1 to make it easier to see the extent to which suicide and subjective well-being are explained by the same factors. Both models explain about three quarters of the international variation in both suicide and subjective well-being.

The answer to the question about Sweden can now be given from a comparable research base. Sweden provides no puzzle for either model, since the Swedish data are almost exactly explained by both equations. But how then are we to explain the fact that the Swedish suicide rate is about average for the industrial countries, while their subjective well-being is much above average? The answer is related to the fact that some variables that are more important in protecting against suicide than they are in promoting life satisfaction (such as belief in God and longevity of marriage) have lower values in Sweden than in the average country. Conversely, the quality of government, which is especially high in Sweden and the other Scandinavian countries, has a greater effect on life satisfaction than on reducing suicide rates.

The two social capital variables, which are a measure of social trust (the average survey answer to the classic question asking if other people can, in general, be trusted) and of the average number of memberships in a variety of community organizations (both variables derived, as are the SWB data used here, from three waves of the World Values Survey), have similar coefficients in both equations, so that even though they are much higher in Sweden than in other countries, they are not part of the explanation of Sweden's differing ranks in life satisfaction and in suicide. In case you are wondering about the effect of long winter nights, it is possible to find a slight role for high latitude as a factor raising suicide rates (Helliwell 2004, Table 5), despite the long-established seasonal pattern showing suicide rates highest when the days are longest.

Perhaps the most important benefit from the mutual confirmation of the life satisfaction and suicide models is that the legitimacy of the subjective

Figure 1
International differences in well-being and suicide
(standardized coefficients from World Values Survey)



measures should thereby be increased in the eyes of those who are more convinced by actions than by words. The two types of data tell remarkably consistent stories, and the SWB data are very cheap and easy to collect, and permit a much finer-grained analysis than is possible using suicide data, since suicide fortunately remains a rare event. However, there are circumstances in which the suicide data can be used in a convincing way even at the community level, in circumstances where there are no SWB data available. Thus, Chandler and Lalonde (1999) found strong confirmation of the importance of local governmental engagement and efficacy in their study explaining suicide rate differences among aboriginal communities in British Columbia. Those communities with self-government and four other markers of local governance and social continuity had zero suicide rates, while the rates in the other communities were up to Russian levels and beyond.

What Are the Policy Gaps?

The conference papers and the well-being data alike confirm that national economies and societies remain very distinct, and that the quality of governance is not only sharply different across countries, but is perhaps the single most important variable explaining international differences in well-

being. Canada and the Scandinavian countries are especially well placed to use these results to inform their design of global strategies. They do not carry the baggage of military and commercial power, yet do have much experience in governance and community development. Being smaller countries, they are also already inherently more aware of what is going on in the rest of the world, and less likely to be inclined to think that there is a single right answer, or that their own institutions are the best of the lot.

All of these countries have already been stalwart and unselfish supporters of multilateral efforts and institutions, and this strand of their engagement deserves continuous support and development. The new research suggests that the old "Washington Consensus" was much too narrowly focused on purely economic policies and outcomes, and did not pay adequate attention to the need for institutional strength as a precondition for successful openness to world markets. The international financial institutions (IFIs) are indeed learning the relevant lessons, and much of the path-breaking research is being done by their research staffs. I think here especially of the large project supported by the World Bank in evaluating different ways of developing governance in a large number of Indonesian communities. This is very much the sort of bottom-up approach that may not make headlines at the outset, and is not a mega project in any sense, but it is likely to provide not just better governance in the participating communities, but useful lessons for those in many other countries and communities.

There is much that can be done beyond the IFIs, since the global reach and governance of the IFIs make them inevitably unwieldy and slow to respond. Individual countries and purpose-built coalitions are much better placed to lead experiments, preferably at the peer-to-peer level, in the development of effective governance. These projects are perhaps most critical, but also most difficult, in the failed states currently wracked by civil strife and riddled with corruption. But there are also many other less dramatic situations where real progress can be made. The organization and delivery of world aid in the wake of the Tsunami can provide not just alleviation of immediate hardship, but also the opportunity to develop new partnerships and linkages in the process. The important lesson from the research is that aid dropping from the sky creates only cargo cults, while aid that is delivered with an eye to institution building can provide the capacity not just to maintain and restore life, but to develop stronger and more secure communities. This lesson applies equally to aid provided by non-governmental organizations and industry as it does to that provided by national governments and the IFIs.

As I argued in *Globalization and Well-Being*, embracing a global strategy of the sort outlined above can and should be consistent with efficient management of the North American economic and political space. But it does

suggest that further preferential North American integration would be likely to lessen Canada's ability to be, and to be perceived as, an independent thinker and doer in the global scene. Canada, and the world, stand to gain from a reversal in the FTA-inspired trend towards preferential trading blocs. A more efficient and promising path is represented by global rules and multi-polar development linkages.

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Discussion 3

William R. White

When I was asked to participate in this panel, I asked myself why the organizers might have thought me qualified. After all, my professional experience is dominated by the twenty-two years I spent at the Bank of Canada, which sounds pretty domestic. Nevertheless, the last ten of these years were largely on the international side. Moreover, I have spent thirteen years working outside the country—three at the Bank of England and a further ten (and counting) at the Bank for International Settlements (BIS). In this latter post, given that the primary function of the BIS is to foster international co-operation among central banks and regulatory authorities, I have had the opportunity first-hand to watch Canadians at work with their international counterparts and to evaluate their contribution. Given this background, I concluded that I was not only knowledgeable enough to comment on the subject suggested, but also extremely pleased to be asked to do so. My evaluation is that, in this international area, at least, Canadians continue to punch well above their weight.

I want to deal briefly with four issues pertinent to Canada's role in international macro policy. First, I look at the contribution of Canadians to the intellectual framework behind the international pursuit of price and financial stability. Second, I examine contributions by Canadians to the process of international co-operation itself, putting existing processes to best use and recommending changes in the processes. Third, I provide an overview of the "people factor," those Canadians whose efforts have particularly enhanced the co-operative process in recent years. Fourth, I consider ways in which Canadians might be able to further support the process of international co-operation in the monetary and financial spheres. It is unfortunate that the

divide between the United States and continental Europe has been widening, perhaps implying an enhanced role for others if co-operative solutions are to be found.

The tone of my comments might appear, to some, to give excessive importance to a distinctively Canadian contribution to international deliberations. As a Canadian living abroad, I admit to a natural bias in this regard that I may not have been able to resist fully. In any event, as the last speaker at this conference, I felt it my duty to help the participants (who were mostly Canadians) leave as proud and "happy" as they possibly could. As John Helliwell has just reminded us, fostering happiness is what good economics is really all about.

Contributions to the Intellectual Framework

If countries individually, or collectively, are to achieve price and financial stability, they must have the proper intellectual framework to guide policy decisions. Canadians have made seminal contributions in this regard, particularly but not exclusively relevant to small open economies. Indeed, Canadian academics like Jacob Viner, Harry Johnson, Robert Mundell, and Ronald McKinnon (along with John Helliwell and Richard Harris, who are here today) can almost be said to have invented the macroeconomics of small open economies. But today I would like to focus more on the contribution of Canadian "officials" to international macroeconomic policy, with emphasis on the intellectual contribution of the Bank of Canada. My point is not that we were always right; indeed, I fear we were often wrong, but we were certainly at the cutting edge of the thinking being done in this area by the international community of officials. Let me begin by listing just a few of our accomplishments with respect to traditional macro issues.

In the pre-war period, Robert Bryce (subsequently Canada's Deputy Minister of Finance) was instrumental in spreading Keynesianism. Fresh from Keynes's lectures in Cambridge (United Kingdom), he went in June 1935 to Friedrich von Hayek's seminar at the London School of Economics and "expounded the new doctrine" (Skidelsky 1992, 532). In early 1936, he went to Cambridge (Massachusetts) (again Skidelsky) to "start the indoctrination of Harvard before the General Theory appeared" (p. 580). After vigorous debate, and in the face of significant international opposition, Canada also became the first industrial country to float its currency in the postwar period. Moreover, it did so in response to upward pressures arising from higher commodity prices generated in part by the Korean War, a fact that those responsible for the Bank of Canada's exchange rate equations will not find surprising. Lurking behind the initial decision to float was the early recognition by Canadian officials that this was required in order to avoid

importing inflation from outside Canada, the United States in particular. And behind this was the further thought that inflation was harmful rather than helpful to economic growth and prosperity—sand rather than grease in the wheels. Indeed, in some of Louis Rasminsky's speeches, the concept of a positively sloped long-run Phillips curve seemed to significantly predate the more formal constructs of both Milton Friedman and Edmund Phelps.

During my time at the Bank of Canada, although certainly not of my doing, a number of other intellectual steps were taken. The Bank of Canada was the first to adopt monetary targeting in 1974, recognizing clearly that floating required some kind of nominal anchor. The Bank was also among the first central banks (preceded by New Zealand, but by only months) to adopt explicit inflation targeting in 1990. I am somewhat ashamed to say, however, that when we did it we had no idea that we were actually following a recommendation of Keynes (1923) in *A Tract on Monetary Reform*, or that the Swedes had for a time followed a similar policy in the early 1930s. The monetary conditions index (MCI), for better or for worse, was also invented by the Bank of Canada, though—I admit, again with some reticence—without a full understanding at the beginning of the insights provided as to its usefulness by the well-known paper by William Poole (1970).[1] Nor was there a great deal of science in the initial choice of the weights in the MCI, which, as I recall, were simply an average of the weights given by the four or more competing macro models being used at the Bank of Canada at the time.

This brings me to another area where the Bank of Canada did pioneering work: large-scale macroeconometric modelling. The Bank was certainly the leader in Canada in this area, and eventually produced work that had a material influence globally. The first of the large models was RDX1 (RDX standing for Research Department Experimental). It was constructed by a joint team of bank employees and visiting academics, reflecting the belief of the Bank management at the time (a belief I still maintain) that these two

1. Poole felt that, whether a monetary authority used the interest rate or the money supply as the intermediate target of policy, depended on the source of the shock: did it come from the IS curve (choose to stabilize the money supply, since then interest rates rise automatically in a stabilizing way) or from the LM curve (then stabilize the interest rate to prevent unwanted effects on the real economy). Similarly, an MCI framework, if applied such that exchange rate changes automatically lead to offsetting interest rate changes to keep the MCI constant, effectively assumes that the shock hitting the exchange market arises in that market and does not have a real counterpart. In fact, if the exchange rate pressure is arising from changing commodity prices, as is very common in a country like Canada, then the use of an MCI framework in a rather mechanical way is not the appropriate policy.

communities could learn a great deal from one another. Among the bank employees, two went on to become Deputy Ministers of Finance for Canada. Among the academics, I would single out John Helliwell (who has just finished another year visiting the Bank of Canada) and Harold Shapiro, who went on to become the President of Princeton University. RDX1 was soon replaced by RDX2, but both were designed for simulation purposes rather than routine forecasting. Given the desire to do this latter task, RDX2 was then replaced with RDXF (F representing "forecasting") in the late 1970s, which had similar simulation properties but was much more "user-friendly." Unfortunately, as time wore on, the limitations of the model's structure became ever more apparent. The end result of efforts to rectify these difficulties was the Small Annual Model (SAM), which led in turn to the Quarterly Projection Model (QPM). Both of these models were pioneering in that they had the capacity for imposing consistent sets of expectations about future developments that could "rationally" determine current behaviour. Moreover, they had consistent stock and flow accounts that allowed movements in endogenous variables to be anchored in long-run sustainability conditions. While at each stage of this modelling work the Bank was well up at the head of the pack, it deserves to be noted that versions of QPM are now being used in many countries around the world as well as at the International Monetary Fund (IMF).

I think too that the Bank of Canada was among the first to use models to determine the setting of the instruments of policy in a practical context. In the late 1970s, Paul Masson (who is here today) and I used a simple renormalization of the estimated demand for money function to determine the interest rate needed to hit (six months hence) the growth rate for the money supply (M1) then being targeted by the Bank. While it was an intuitively obvious way to proceed, a problem with the process became evident almost immediately. Although the fit of the equation was remarkably good, the size of the error term was still large enough to ensure that even the direction of the implied interest rate change was dependent upon assumptions made about the error term's future behaviour. As Gerald Bouey once remarked ironically in a semi-public speech (and I paraphrase), "Thanks are due, for giving the Governor something on which he can really take a stand." While we eventually dealt with this problem in a practical way, the experience underlined the fact that there can be a vast difference between statistical and economic significance. QPM marked another step forward in that both the policy rate and the exchange rate could be endogenized to ensure that the inflation target of that time was hit two years hence. In the end, there was nothing mechanical about how policy rates were set, but these insights from the model served as a useful input into the regular policy-making process.

Another aspect of the intellectual contribution made by policy-makers at the Bank of Canada was their ongoing willingness to admit the shortcomings in their policy framework and their readiness to move on to new thinking and to new ways of doing things. I think that in light of some recent developments, they might be well advised to subject the current inflation targeting framework to a similar critical analysis. However, I will return to this in a moment.

And let me add briefly that, if Canada has been something of an intellectual pioneer on the macro side, this has also been true with respect to issues of financial restructuring. Canada was one of the first countries to remove capital controls after World War II, and subsequently to remove controls over interest rates. Moreove., the Bank of Canada actively promoted the development of short-term money markets in Canada with a view to relying on "market-determined prices" as the centrepiece of monetary policy. In this regard, it predicted but was consistent with the recommendations of the Royal Commission on Banking and Finance (the Porter Commission of 1964), which emphasized the merits of greater competition, freer markets, and better regulation to enhance efficiency. Seen against the backdrop of other countries, where extensive government controls in the financial sector were still thought desirable in light of developments in the 1930s, this was a groundbreaking development. Canada was also a pathbreaker in actively promoting "national" banking to exploit regional diversity in lending. And finally, to bring us right up to date, Canada was the first industrial country to agree to the IMF carrying out a Financial Sector Assessment Program. The logic was that we had nothing to hide and, if there were problems to be fixed, then the sooner they were addressed the better. A large number of these welcome structural initiatives are now being imitated in many emerging-market economies around the world.

Contributions to the Process of International Co-operation

Canada's representatives have made a number of contributions to the process of international co-operation. Within existing frameworks, they have contributed to raising the quality of the international dialogue and have often served a useful function as honest broker. Moreover, at various times, they have contributed to improving the processes themselves. Their ability to do these things rests on a number of Canadian attributes, albeit attributes likely shared with some other smaller countries. Consistent with what has been noted above, the generally high quality of the ideas put forward by Canadians creates an atmosphere of intellectual respect. The fact that the country is relatively small and non-threatening is another plus, as is

Canada's reputation for trustworthy and not entirely self-serving behaviour. Finally, there is a certain Canadian deference and modesty of approach that seem to avoid putting people's backs up. I very much hope that my rather "immodest" presentation today will not prove a setback in this regard.

As to the quality of the international dialogue, it has been my observation that Canadian contributions have normally been exceptionally well prepared, which may reflect the relative smallness of Canada. This means that international issues must be taken seriously, rather than treated as a distraction from the domestic business that is really important. A further personal observation concerns those Canadian presentations I have heard that seem to have generated the most enthusiastic response. Generally, they have emphasized "ideas" that were of potential use to others, rather than focusing on the specifics of what was going on in Canada. The sad truth is that nobody really cares about the latter, so the intellectual track seems clearly preferable.

As to the honest broker role, which we all learned about in Political Science 101, I think it really does exist in the area of international financial co-operation. While I could give many examples, a quote from the recent biography of Louis Rasminsky seems to me to be perfectly illustrative. Bruce Muirhead (1999) quotes Rasminsky that "A large part of [his] intellectual life was invested in the idea of international collaboration and the machinery that made collaboration possible" (p. 82). He believed that multilateralism was the only solution to global problems, and at Bretton Woods, he "became the consummate mediator between the British and US negotiators." As Lionel Robbins wrote at the time, "Rasminsky is so competent and so obviously disinterested that it would be difficult not to take him seriously" (Muirhead 1999, 104). I think that many other Canadians have shared these attributes over the years, although likely none to the same remarkable degree.

Turning now to Canadian contributions to changing the process itself (the machinery just alluded to), we find again that there are many illustrative examples. As a counterpoint to more historical allusions, a recent and important paper by Mark Kruger of the Bank of Canada and Andrew Haldane of the Bank of England (Haldane and Kruger 2001) puts forward the case for notional lending limits for the IMF. The proposal attempts to bridge the gap between the US wish for discretion in the nature and size of Fund lending and the wish of the continental Europeans for more rule-based behaviour, against the backdrop of a common belief that Fund lending programs cannot continue forever to expand in size. Closely related in time, Canada's agreement to issue foreign currency denominated bonds containing collective action clauses (CACs) was an attempt to lead by

example and to induce emerging-market economies to do the same. CACs hold the promise of less disorderly sovereign defaults and, for a variety of reasons, are now being widely used. And finally, since John Crow is in the audience today, I would be particularly remiss if I did not mention his efforts to improve the process of international co-operation at the BIS. When he was Chairman of the G-10 Governors, John made a spirited attempt to increase the membership of the G-10 to include other important countries. While he failed to do so at that time, the BIS found other ways to pursue his initiative for greater inclusiveness. It now welcomes a very much larger number of countries, including virtually all of the systemically important emerging-market economies, to its various meetings, and has expanded its share membership along similar lines.

The People Factor

For many years, Canadians have been disproportionately represented at the international level, and only partially because we are competent and we come cheap. Today, if we look at the major international institutions concerned with economic issues, I would have to begin by noting Malcolm Knight, who heads the BIS, and Donald Johnson, who heads the Organisation for Economic Co-operation and Development (OECD). Moreover, each happens to have among his senior staff other Canadians, some like myself and Michael Kennedy, fortunate enough to have also spent many years at the Bank of Canada. And of course, at the IMF and World Bank, there have been innumerable Canadians in senior positions, including William Hood and, more recently, Paul Masson. While not an international financial institution, the United Nations is also very interested in international macroeconomic issues. The fact that another Canadian, Louise Fréchette, formerly Assistant Deputy Minister of Finance, is Deputy Secretary-General, should also be recorded.

Turning now to the international groups of national experts who co-operate on financial stability issues, generally meeting at the BIS, Canadians have again made and continue to make a big contribution. Nicholas Le Pan, Head of the Office of the Superintendent of Financial Institutions (OSFI), led the Accounting Task Force of the Basel Committee on Banking Supervision. Moreover, he is currently in charge of what is arguably their most important task force today—the worldwide implementation of the New Basel Capital Accord. Tim Noël of the Bank of Canada was instrumental in the early work of the Committee on Payment and Settlement Systems (CPSS), as was Charles Freedman, who also chaired a major working group on the monetary implications of electronic money. John Palmer, the previous Superintendent of OSFI, was chosen to head the most controversial of the

first three working groups set up by the Financial Stability Forum (that on offshore financial centres), and John Thompson was the first Chairman of the International Association of Insurance Supervisors. Finally, Jean-Pierre Sabourin of the Canadian Deposit Insurance Corporation (CDIC) and John Raymond Labrosse (currently of CDIC but also ex-Bank of Canada) have been instrumental in setting up and continuing to direct the International Association of Deposit Insurers. So, I repeat, on the people side, we continue to punch above our weight.

A Canadian Contribution Looking Forward

One problem I see is that the transatlantic divide, which has widened in recent years, could be maintained or even widened. The role that might then be played by honest brokers could well be enhanced. I see two major areas where people need to say the "unsayable" with a view to promoting discussion between the United States and much of Europe. In both cases, the objective would be to promote steps to avoid potential financial crises.

The first and more immediate issue has to do with the US dollar and the prospects of a "disorderly" solution to its unsustainable level. The dollar is currently being supported in effective terms by massive foreign exchange intervention on the part of a number of foreign governments, particularly, but not exclusively, in Asia. On the one hand, it could be argued that this should immediately come to a halt, since it is impeding the external adjustment process in two ways. First, intervention itself impedes the exchange rate changes that provide the impetus for needed substitution between tradables and non-tradables in creditor and debtor countries, respectively. Second, the purchase by foreign governments of US Treasuries may be pushing down long-term interest rates in the United States, thus increasing absorption rather than decreasing it as needed. On the other hand, it could also be argued that a sudden halt to such behaviour, and a sharp decline in the value of the dollar, could have unwanted effects. In particular, if US long rates rose precipitously from current low levels, some of the "bubbly" components of today's financial markets (high risk and sovereign spreads, the value of equities and real estate, and volatility) might tip over into the "bust" phase with significant implications for growth and employment. This would clearly affect the United States, but creditor countries (to the extent that their wealth was held in dollar-denominated assets) would also be affected by such financial events. In the world in which we live, exchange rate changes now have much more than just trade substitution effects.

Perhaps there is merit in discussing the need for a Plaza-like agreement—but with the Asians being important players—to arrive at some intermediate

solution. Many Europeans would view this positively, but the US view seems less receptive. As John Connolly once famously said, "Our dollar, your problem." Canada has a particular interest in this issue, since market pressures leading to a lower US dollar are now being unnaturally channelled into sharp upward movements for those relatively few currencies that are actually freely floating. Obviously, the Canadian dollar is one of them.

The second issue is less pressing but no less important. I and some of my colleagues at the BIS believe that a combination of economic and financial liberalization, allied with a monetary policy solely focused on CPI (or personal consumption expenditures) inflation, has made the world much more prone to financial booms and busts. In effect, a liberalized financial system (for all its benefits) is more prone to credit excesses than a repressed one, and there is no resistance to this when the monetary authority observes that measured inflation is well under control (again with all its benefits). This kind of thinking leads one to conclude that we need to develop an effective macrofinancial stability framework (involving both monetary and regulatory policies) to deal with such problems. One important element of this would be a much more symmetric response of monetary, fiscal, and regulatory policies over the cycle.[2] Again, many Europeans are sympathetic to these ideas, but the thinking of officials in the United States seems much less so. Since financial booms and busts can have economic implications well beyond domestic borders, an international dialogue on such issues would seem to have merit. In summary, Canadians may have done a lot to foster international co-operation in the pursuit of monetary and financial stability, but there remains a great deal left to do.

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General Discussion*

Paul Masson asked the panel to comment on a view that called for recognition of Canada's diminished influence in international forums and for a foreign policy directed towards achieving specific and realistic objectives with the United States. With respect to international financial institutions, Masson noted that recorded failures with respect to financial crises and developmental shortfalls were not due to poor thinking by staff in these institutions but rather to the lack of will to carry out reforms. John Helliwell noted that it was unlikely that the current US administration would be sensitive to Canada's input. For another, what mattered ultimately was the quality of public institutions. We should strive to improve them at home and share our best with other countries. Building global trust and relationships was more important for Canada than courting power. Bill White added that the world had changed with the growing US unilateralism. While this called for more multilateral talks, it was unlikely that the US administration would be responsive to these initiatives. He contrasted the leverage that the International Monetary Fund possessed to the role of the Bank for International Settlements, which was to provide a forum to exchange views. Mark Carney also doubted that the US administration would listen to Canada.

Bill Robson asked Bill White to elaborate on how monetary authorities could deal with asset bubbles in an inflation-targeting regime. White responded that we could be facing this situation now, as global supply has expanded and partly shifted to low-cost producers (e.g., China) as financial liberalization proceeded apace in many countries. The result is a world

* Prepared by Robert Lafrance.

awash with liquidity—monetary policy is generally too expansionary—but with limited inflationary pressures in goods markets. In contrast, asset-market prices have risen considerably. John Crow added that in a low real interest rate environment, speculation is encouraged. He asked Mark Carney who had the most influence in setting the agenda at G-7 and G-20 meetings. Carney replied that the agenda was driven by finance ministers, not leaders, that the G-7 dominates the G-20 agenda, and that the chair in the G-7 has a larger influence.

Chris Ragan asked the panel to comment on how global imbalances could be corrected and the risk of a disorderly US dollar depreciation. Should we be sanguine? What role could Canada play as an honest broker? What are we likely to see? John Helliwell referred to earlier work on fiscal and external deficits. He said that a lot depended on how US fiscal policy would play out going forward and that a major dollar correction would probably occur more abruptly than what econometric models would indicate. Bill White said that China has to be the first mover (in freeing its currency), but it won't be because of concerns about domestic financial fragility. White added that US fiscal policy should retrench, but this won't happen either. A major problem is that, while most countries want the United States and China to slow down, they depend on these two locomotives for their own growth. Mark Carney pointed out that Canada has stayed the course on macropolicy, has not complained about exchange rate movements that are required to resolve global imbalances, and that it has done more than its share on the latter. Canada has a seat at the table. We should engage in constructive dialogue to persuade others, notably China, that proposed adjustments to their policies are in their own best interests.

Farid Novin asked what the goal of the G-7 should be—should it be limited to members' own interests or to something broader? Mark Carney suggested that our economy is so open that our interests can mesh with the common interests of a well-functioning global economy, but that our influence is limited, so we have to choose our issues. Bill White said that the current marriage of convenience between the United States and its Asian financiers was the biggest vendor-financing operation in history and that it could not go on for ever. He thought a market solution would be disorderly and that policy co-operation would be preferable. John Helliwell argued that research has shown that human beings are less selfish than portrayed in economic theory. Humans are social animals and this applies to countries as well. So co-operative solutions are quite feasible. He then explained the value of small nation states that provide a diversity of ways of tackling social and economic issues.

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